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LIGHT TRANSFORMING REFLECTORS.

On another page we present an interview with Dr. Peter Cooper Hewitt in regard to the remarkable utilization of the phenomenon of fluorescence which he has made, in transforming luminous radiation. This invention, which is of special interest in its application to the Cooper Hewitt mercury-vapor lamp, employs a fluorescent light-transforming reflector to convert light of one range of wave lengths into light of another range of wave lengths further down toward the red end of the spectrum. The fluorescent reflector becomes in fact a secondary light source, excited by certain rays from the original lamp constituting the primary light source. Applied to the present mercury-vapor light, it transforms the predominant wave lengths of that light into longer waves, which it adds to the rays emitted directly from the tube, thereby giving a resultant illumination of wholly altered character.

Thus, it is believed that the feature that made the mercury-vapor lamp undesirable for some phases of illumination, because of its spectral deficiency, will be removed, and it is the expectation of its sponsors that it will rapidly extend its usefulness into places hitherto denied to it.

It seems not unlikely, as Dr. Hewitt points out, that light-transforming reflectors may be applied to the enrichment of many light sources which are now in common use, but which in their present condition are lacking in certain rays necessary to be introduced in order to make these lights thoroughly acceptable. The use of tinted lamp shades in attempting to soften the light, as well as to diffuse it, indicates a need in illumination; such shades, of course, have a mere color-straining effect and are incapable of introducing rays which are not in the light already, and it remained for Dr. Hewitt to meet the need on a true scientific basis. It may be anticipated that the light given by the incandescent gas mantle, for example, will be much improved by equipping the mantle burner with a fluorescent reflector furnishing certain longer wave lengths. But it is in the fields of electric-lamp manufacture and electric lighting that fluorescence may now be expected to play the most important rôle, by transforming hitherto objectionable radiation into useful light, and by rearranging the spectra of sources hitherto poorly adapted to commercial illumination.

THE ARTIFICIAL LIGHTING OF ART GALLERIES.

One of the most exacting problems in the realms of interior illumination is the lighting of art galleries. The requirements for the ideal illumination of galleries for display of pictures, tapestries and other mural decorations are that the light shall correspond almost exactly with daylight color values so that the color effects in the objects exhibited shall not be distorted, also that the walls shall be adequately and very uniformly illuminated, and finally that the source of light and other objects in the room shall be relatively inconspicuous, so that the attention shall not be distracted from the mural display.

These strict requirements are not fully met by any direct, or even indirect lighting system. Any unscreened direct system is too barbarous for serious consideration in this connection. Even where the fixtures are provided with diffusing globes, they are bound to attract the eye. A pure indirect system with pendent fixtures throwing their light on the ceiling is out of the question because most modern picture galleries secure their daylight illumination through glass skylights so as to give a maximum of wall surface. Cove lighting is objectionable because it makes the cove the brightest part of the room. The use of trough light reflectors may be partly successful if these are screened from view by an additional canopy so that their unsightly appearance and direct light may not be obtrusive; however, they are apt to give uneven light distribution on the wall surface and undesirable reflections from paintings.

A very happy solution of this difficult problem has been made by Mr. Putnam A. Bates, who designed the engineering features of the Morgan Memorial Building in Hartford, Conn. On other pages in this issue is given a description of the lighting of the picture galleries of this building.

In this installation the lamps are not in the rooms at all and yet the lighting is not a strictly indirect system, although it has all its merits and none of its disadvantages. Ingenious application is made of the admirable idea of directing the artificial light in the same way as the natural light by day. While this principle is not new, it is not easy of execution, as shown by the relatively few instances where it is applied. When it is combined with the provision of light approximating in quantity and quality that produced by day, it is theoretically possible to achieve the ideal, where the transition from daylight to artificial light is scarcely noticeable. Where such a result is actually attained and with a relatively high degree of economy, as in this instance, those responsible for it are to be heartily congratulated.

In this connection also it is appropriate to commend the donor of the building referred to, not only for the munificent gift to the city of his birth, but for his requirement in that gift that the workmanship and equipment of the building should be the best obtainable. As shown by the lighting of the art galleries and the other features referred to in a previous article, the engineering and scientific features were given the same careful attention as were at once seen to be imperative for the architectural and artistic features. If other philanthropists would append similar conditions to their gifts we would see more utilitarian and scientific features embodied in our monumental buildings.

THE EFFECT OF RADIATION UPON THE EYES.

The principal effect of radiation upon the eye is in stimulating the retina to give the sensation of light when the radiation is of the requisite wave length. We know that where the visible radiation is too intense, the delicate retinal membrane may be injured, the injury arising, apparently, from the excessive stimulation of the retinal elements—the end-organs of the optic nerve.

A second effect of radiation is the energy-effect, due to the conversion of the energy into heat by absorption of the radiation. This is the effect common to all matter not perfectly transparent, and so far as experience goes, the eye is no more sensitive to this effect than other parts of the human organism. Indeed, it is doubtful whether the retina is as sensitive to heat and cold as the skin, and it is very probable that a considerable quantity of infra-red radiation may impinge upon the retina without producing either sensation or injury. The statement is often made that infra-red radiation, in intensities greater than would be suitable in the visible wave lengths, is injurious to the retina, but there is no evidence to support this contention. On the contrary, experiments have been made which indicate that solar radiation, from which the visible rays have been removed, may impinge for a short time directly upon the eye without harm. Since this is not universally conceded, it would be well, however, for some experimenter with suitable apparatus to conduct decisive experiments along this line. The intensity of radiation in successive trials might be increased until a maximum is reached where some effect is observed.

It is probable that little infra-red radiation actually reaches the retina, as the humors, lens and cornea are not transparent to radiation consisting of long wave lengths. It is thus sheltered from those frequencies lying far beyond the visible spectrum, not only upon the infra-red side, but also in the ultra-violet.

A third effect of radiation is found in the purely physiological results due to the action of ultra-violet light. It has been known for some time that this radiation is harmful, not only to human tissues, but also to microscopic organisms, yet it is only in recent years that this fact has received general recognition and that the details of the effects are being studied out. Some of the earliest effects noted were in diseased conditions of the skin, as in small pox and lupus. In the treatment of the latter, it is endeavored to kill the micro-organism while keeping the intensity too low to injure the tissue. The bactericidal action of these rays is now gen-

erally recognized, and is being applied in various ways. As for the eye, most of the ultra-violet rays are absorbed by the outer media, and little of such radiation reaches the retina. The bad effects are consequently noticed in the anterior portions of the eye, and are experienced whenever that organ is exposed too long or to too intense radiation of that character. Besides the objection of glare, consequently, high-temperature sources or those especially rich in these rays are objectionable also on this account, and another argument is thus furnished for indirect illumination when sources of this character are used.

ELECTRIC LIGHTING FOR AUTOMOBILES.

When electric manufacturing companies issue special literature on wiring systems and accessories for the electric lighting of automobiles and lamp manufacturers are making lamps in many special forms peculiarly adapted for this purpose—and these are already accomplished facts—the use of electricity for lighting automobiles may truly be said to have passed the experimental stage. In fact, such headway has already been made that the passing of oil and acetylene for automobile lights can safely be predicted.

Assuming for the moment that the incandescent electric lamp is inherently suitable for the purpose, there are many obvious reasons why it should be preferred to other illuminants for automobile lighting. The chief of these are: (1) No need of adjustment, cleaning, etc. (2) Can be switched on or off from the driver's seat. In passing through cities and towns, quick change from headlights to side lights can be made by a simple switching. (3) No danger of igniting inflammable liquids or vapors; hence, portable electric trouble lamps may be carried and used with perfect safety for road repairs and adjustments to the machine. (4) No interference from wind or rain. (5) Facility with which it may be focused in special reflectors to utilize the light to the best advantage. (6) Less operating cost than other lighting systems, for equal illumination.

For all the above reasons electricity possesses material advantages over oil and acetylene. It goes without saying that the electric lamp is the only logical means of lighting for electric vehicles, but for gasoline cars electricity also possesses marked advantages. It may not at first seem possible, but it has absolutely been proved by photometric measurement, that the special forms of rugged high-efficiency, low-voltage tungsten and tantalum lamps, developed for automobile lighting, are actually superior in illumination value to even the acetylene lighting systems ordinarily employed on gasoline cars, and moreover cost much less to operate. Indeed, it is stated on reliable authority that many automobile designers, both in America and Europe, are considering the adoption of electric lighting systems in their standard cars for the next season.

The use of a dynamo and storage battery (in other than electrically driven vehicles) is usually to be preferred to an independently charged battery, in order to minimize weight and replacement troubles and also to supply a constant voltage to the lamps. Although some practical schemes along this line have already been put into effect, there remains plenty of room for ingenious inventors to devise a combination of light storage battery and constant-voltage generator operable within a wide range of engine speed, and a simple and reliable automatic switching device to regulate the charging of the battery. This generator could also be made to furnish current for the ignition system, and thus obviate the necessity for carrying a separate magneto for this purpose. The use of a pilot lamp or meter lamp on the dash will be ample precaution against burnouts escaping the driver's attention.

To sum up: In no feature does the oil or acetylene lamp excel the incandescent electric lamp for automobile lighting, and in many respects the latter has decided advantages. Without a doubt electric lighting for automobiles will soon supersede all other systems on the better-class cars. Any improvements yet to be made will probably be on the lines suggested above, the last great development being the most radical and logical of all, standardization.

ESSENTIALS IN MINE ELECTRIFICATION.

At a recent meeting of mining men in Alabama, Mr. Morris Bush in his paper on "Electrification of Mines" (abstracted elsewhere in this issue) said: "It is seldom recognized . . . by most mine superintendents that a track underground should be as good as a track outside."

Mr. Bush was speaking of his own successful experiences in the use of electric locomotives in mines. What he says about the trackways is even more applicable to the electric equipment. Limited headroom, inflammable gases and dust in the atmosphere, general dampness, presence of acid in mine waters, lack of electrical knowledge on the part of the mine workers, all these considerations increase the hazard in mine work, and call for more special precautions than are necessary in electrical work above ground. Apparatus which is perfectly safe under ordinary conditions may be entirely unsuitable for use underground. Extraordinary care must be taken to make it practically foolproof; insulation must be chosen which will be reliable and lasting under the special local conditions; installation must be done by the most competent workmen and supervised by an expert; and, chief of all, an eternal vigilance must be exercised by a skilled electrical engineer in charge of the electrical apparatus. Periodical inspection is an absolute necessity. This must be done by one who is familiar with all the technical details of the installation, and not intrusted to an ordinary foreman or workman. When mine superintendents realize the importance of these things, the electrically operated mine will be as safe from accidents or breakdowns as is possible.

Edison Kinetophone.

The kinetophone is a combination of the kinetoscope and the phonograph, which Thomas A. Edison has just perfected. He has been working on the invention for several years. By its use the moving picture can be supplemented by music, conversation or any other sounds appropriate to the occasion.

A demonstration of the apparatus was recently given at Mr. Edison's home to an audience of scientists and newspaper men, and the effects were very impressive. The inventor expects to improve a few of the details before bringing the apparatus into general public use.

The kinetophone will enable grand operas, dramas, speeches and other interesting events to be reproduced in their entirety.

Meeting of Electrical Inspectors.

Announcement has been made that the sixth annual meeting of the Western Association of Electrical Inspectors will be held in Omaha, Neb., October 11, 12 and 13. Headquarters will be established at the Hotel Rome.

The president of the Association is Fred G. Dustin, of Minneapolis, and William S. Boyd, of Chicago, is secretary.

Annual Meeting of Jovians.

The eighth annual meeting of the Order of Rejuvenated Sons of Jove will be held at Birmingham, Ala., October 13, 14 and 15. Headquarters will be established at the Hillman Hotel. The various committes that have been appointed have their work well in hand and a most successful meeting is predicted.

International Congress of Radiology and Electricity.

The programme of the Congress which is to be held at Brussels, September 13, 14 and 15, has been announced, and is made up largely of papers dealing with radioactivity, radiation and X-rays. Papers on these subjects will be presented by a number of Americans, including Professors Barnes, Boltwood, Hale, Hull, Millikan, E. F. Nichols, Richardson, and Kovarik.

A number of papers will be presented on topics more electrical in their nature, largely by German authors. Some of the more interesting of these are: "The Magnetism of Alloys," by Prof. Richarz; "Power Measurements with High-Frequency Currents," by Prof. Simon; "Phenomena of the Electric Arc," by Prof. Jaeger; "The Production of Rotary Electrostatic Fields," by Prof. von Lang; "Thermo-electricity," by Prof. Lecher; "The Electric Arc with Liquid Electrodes for Generating Electric Waves," by Mr. Goldschmidt; "Conductivity of Fluorescent Solutions," by Mr. Rasenfosse; "Electrical Properties of Colloidal Solutions," by Dr. E. F. Burton; "Positive Electricity," by Sir J. J. Thomson; "The General Equations of the Electromagnetic Field" by Prof. Lorentz.

The Congress is divided into three sections, the first dealing with terminology and methods of measurement, the section with fundamental theories and the study of radiations, radioactivity, ionization, etc., and the third with biological effects.

Central Electric Railway Association.

The first meeting, after the summer vacation, of the Central Electric Railway Association will be held in the Claypool Hotel, Indianapolis, Ind., September 22. There will be a morning and afternoon session. After a business session George J. Smith of Chicago will give an illustrated talk on "Large Station Units." The meeting promises to be largely attended.

"Efficiency and Design of High-Tension Insulation" is the subject of a paper to be presented by C. A. Austin, of Mansfield, Ohio, and W. E. Daviss will read a paper on "Direct-Current and Alternating-Current Motors."

First Telegraph Rate Filed.

The first telegraph tariff has been filed with the Interstate Commerce Commission by the Telepost Company, of New York City. The new Interstate Commerce Act gives the Commission jurisdiction over the telegraph companies and requires them to be classed in the same category as the railroads.

This tariff gives the telegraph tolls effective October 1. These tolls are as follows:

"Telegrams between any two cities connected by telepost lines, twenty-five words for twenty-five cents. Each additional ten words or fraction thereof, five cents."

"Teleposts between any two cities connected by telepost lines, fifty words for twenty-five cents and five cents for every additional ten words or fraction thereof."

"Teletapes between any two cities connected by telepost lines, 100 words for twenty-five cents. Each additional twenty words or fraction thereof, five cents."

"Telecards are postal cards, either handed in at or mailed to a telepost office, transmitted over the wire and then mailed at destination. Rate is ten words for ten cents. Not more than ten words can be sent on a telecard."

Color Vision at the Ends of the Spectrum.

When the extreme red is compared with the less extreme red of the spectrum in Maxwell's color-box, no difference can be perceived after the brightnesses are adjusted to equality, says Lord Rayleigh in *Nature*. At the other end of the spectrum there is a tendency of the extreme violet towards red, however, so that the addition of a slight amount of red to blue will make a color match with the violet. In certain observers the latter was not verified. He considers that normal color vision involves three primary color sensations, but it is possible that a fourth exists in certain persons

Wireless on Aeroplanes.

Wireless telegraphy experiments with an aeroplane were conducted recently at Hammondsport, N. Y., where J. A. D. McCurdy, Lieutenant Culver, the electrical expert, who is attached to the signal corps of the Department of the East, and H. M. Horton, the inventor of the sending apparatus on the aeroplane, both sent and received messages.

Major Samuel Reber, chief signal officer of the Department of the East, was very much impressed with the result of the wireless experiments at Sheepshead Bay, and decided to send Lieutenant Culver to Hammondsport. The latter devised the receiving apparatus used by Mr. McCurdy on his Curtiss biplane. This with Horton's sending machine enables the passengers on an aeroplane to receive as well as send messages.

Lighting for the Mardi Gras.

Elaborate preparations have been made for lighting Coney Island during the Mardi Gras celebration from September 12 to 17. A number of new lighting effects have been devised for the floats, and the street lighting will be more beautiful than ever.

Edward P. Hyde.

The art of illumination has in this generation reached the point where it is no longer being followed by empirical methods, but is receiving a great deal of help by the co-operation of scientists and the application of scientific methods. As a result we have seen in the last decade a very marked advance in not only electrical illumination, but that from all sources.

When the National Electric Lamp Association, falling in with the spirit of the times, decided to establish a laboratory for purely scientific research along the lines connected with illumination, it chose as a director of this work one who was eminently qualified by his ability, his education and his previous work in the field to carry out most fully the ideas of the men who were instrumental in establishing the laboratory. The man selected for this work from among the large number of eligibles in the field of illumination was Edward P. Hyde.

EDWARD P. HYDE.
Director of Physical Laboratory, National Electric Lamp Association.

Edward Pechin Hyde was born in Baltimore, Md., January 3, 1879, and received his early education in the schools of that city. After passing through the Baltimore City College he entered Johns Hopkins University, and was graduated with the bachelor's degree in 1900. He then entered upon graduate studies in physics and mathematics, as the holder of a fellowship, but before completing his work for the doctor's degree he was appointed to the position of laboratory assistant in the National Bureau of Standards at Washington, D. C. His studies were, however, continued while occupying this position and the degree of Doctor of Philosophy was conferred upon him in 1904.

Upon entering the Bureau of Standards, Dr. Hyde's work was in the section devoted to the photometry of electric incandescent lamps, and before long this part of the work of the national laboratory was put under his charge. When the Bureau secured its new permanent quarters in Northwest Washington in 1904, Dr. Hyde superintended the installation of the new photometric laboratory, which is perhaps the most perfectly equipped for this work to be found anywhere.

The work of the photometrical section was developed by Dr. Hyde until it received national recognition, and about this time he was sent to Europe by the Bureau of Standards to study the methods in vogue in the European laboratories, and to make comparisons of the photometric standards in use by our own and by foreign governments. He was promoted in 1905 to the position of assistant physicist and later became associate physicist.

In 1908, Dr. Hyde was called to Cleveland to assume charge of the newly established physical laboratory of the National Electric Lamp Association. This opened a field for which the new director was especially fitted, and which was in the line in which he was most deeply interested and which had become his life work. The equipment of the new laboratory and the selection of a corps of workers capable of solving the problems which were to be taken up were questions which required the exercise of the greatest consideration and good judgment of the director. A trip to Europe was taken for the purpose of securing the best available apparatus. The splendid start which has been made in this laboratory, described on other pages of this issue, testifies to the marked ability of its director.

When it was proposed to organize the Illuminating Engineering Society, Dr. Hyde was one of those who took a very active interest in the new project and became one of the charter members of the infant society. He has been from the start very active in its work and at the meeting of the Society in New York on January 14, 1910, his interest and ability were recognized by his election to the office of president of the Society. In furthering the interests of this Society the work of Dr. Hyde has been indefatigable and especially since assuming the office of president he has spared no time or efforts in promoting the success of the Society. As a result of his efforts and of those of the efficient membership committee, the membership has been very greatly increased during the current year. Due to the initiative of Dr. Hyde, the Society has also undertaken something entirely unique, in the establishment, in co-operation with Johns Hopkins University, of an educational course of lectures on the subject of illumination, which are to be given at the University in connection with the next convention of the Society in October of this year. Dr. Hyde will lecture upon the subject, "The Physical Characteristics of Luminous Sources."

Dr. Hyde is also a member of the American Physical Society and of the American Electrochemical Society. He is a fellow of the American Association for the Advancement of Science and an associate of the American Institute of Electrical Engineers. He is also a member of the Union Club of Cleveland.

The principal athletic diversion of Dr. Hyde is upon the tennis court.

He was married in Baltimore in 1904, to Miss C. Virginia Getzendanner, and has one daughter, Dorothy.

Northwest Electric Light and Power Association Convention.

The third annual convention of the Northwest Electric Light and Power Association was held on the steamer *Queen*, which left Seattle on Friday night, August 26, for a three-day cruise. The members assembled at the Hotel Butler and then went aboard ship. The trip included stops at Everett, Bellingham and Vancouver.

The holding of a convention on a steamer is a somewhat unique method of procedure. It has the advantage of keeping the members in close touch with the sessions, but adds the danger of making them unfit to take part in the discussion for other reasons.

Of the papers read at the meeting we present below abstracts of those by D. L. Huntington on "Depreciation," by W. J. Grambs on "Notes on Rate Making," and by A. C. McMicken on "Methods of Obtaining Business."

METHOD OF OBTAINING NEW BUSINESS.

This paper reviews the history of the development of the new-business departments of central stations. The paper then discusses the functions of such a department and the work to be accomplished, pointing out the success met with in some of the larger cities. The author advocates constant solicitation along established lines; ample, trained soliciting capacity to see and develop new fields; advertising in varied and attractive form; display rooms well equipped with current-consuming devices; popular demonstration of electrical applications and the giving of engineering advice free to customers.

NOTES ON RATE MAKING.

This paper discusses the rates for light and power in use at the present time. The author expresses the opinion that the primary and secondary rate scheme and the readiness-to-serve scheme, based on maximum demand, can combine practically all of the features which go to make up an equitable rate. A theoretically correct rate, that is, one which will divide the cost and profit equitably between all consumers, would be extremely complicated, and would cause dissatisfaction because the very short hour users would have to pay an extremely high rate per kilowatt hour; location of customers as regards point of generation would have to be taken cognizance of on account of difference in line losses; and large consumers would have to pay a rate that would increase isolated-plant competition. Since it is not practical to charge the short-hour user and the large consumer at the theoretically correct rate, the additional profit must be made on the intermediate consumers. In making up or revising rates the author states that it is always best to determine the theoretically equitable rate for each class of consumer and to vary this as occasion demands. In making up this theoretical rate the author considers the following general divisions of expense to be taken account of: (1) A consumer's charge; (2) a capacity charge; (3) an output charge; (4) profit. The consumer's charge should cover cost of reading meters, collecting, billing and all cost, which vary with the number of consumers and is usually arbitrarily fixed at $1.00 per month. The capacity charge should cover bond interest, general salaries, general expense and all other items due to the capacity of the station and distributing system. The output charge should cover operating supplies and all expenses depending on the output of the station, and profit. The fixed charges on the operating plant should be divided among consumers in direct proportion to the consumer's effect on the peak load. The fixed charges on the distributing system must be found for each class of service separately. The paper concludes with a lengthy digest of a paper read at the convention of the National Electric Light Association, at St. Louis, by S. E. Doane.

DEPRECIATION.

This paper comments on the subject of depreciation as one of the most serious financial problems to be met by central-station companies. After a brief introductory paragraph in which the importance of the proper consideration of depreciation is emphasized, the author outlines three methods of arriving at depreciation charges which have come to his notice. First—Some properties arrive at the depreciation charge by taking the difference between an arbitrary percentage of their gross receipts and the amount charged for maintenance. Second—Other concerns have gone into the most elaborate determination of depreciation items, taking each piece of apparatus and each installation as it is made and opening a separate depreciation account for each item, and extending the depreciation charge yearly, totalizing in order to arrive at the whole depreciation of the property. The third method consists of taking the plant as a whole, grouping the various classes of apparatus, machinery, etc., into classes which are arbitrarily assumed to have about equal rates of depreciation. From these figures on a plant as a whole the charge for depreciation is arrived at. It is then determined what percentage of the total investment should thus be written off. In commenting on these three methods the author says of the first that it is an easy method but has no logical basis. He says the second is probably more nearly accurate than any other method which has been used to any extent, but it has the disadvantage of being extremely cumbersome. The third method does not entail anything approximating the labor and clerical force required by this second method and yet it has a logical basis and it seems probable that it is along such lines that depreciation estimates will be arrived at in the future. The paper further points out a few essential factors to be considered when arriving at a depreciation charge. The value of real estate, water power rights, freight and passenger terminal lands should be taken as an offset against the depreciation charges, as they will most likely increase in value.

Electrical Exports for July.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has just issued its monthly summary of imports and exports for the month of July. From this it appears that the electrical exports were quite heavy, the total not only exceeding the preceding month but approaching the record total in the high month of May, 1910. As compared with last year the improvement is about sixty per cent, the increase being a little greater in the heavier exports (machinery) than in instruments and other appliances. In fact the month of July shows the largest exports of electrical machinery for several years.

The comparative monthly data are as follows:

Electrical—	July, 1910.	July, 1909.	June, 1910.
Appliances	$839,059	$567,795	$902,593
Machinery	745,419	391,195	586,202
Total	$1,584,478	$958,990	$1,488,795

The principal countries to which electrical products were sent last July, together with the values of these exports are as follows:

	—ELECTRICAL—	
Exported to—	Appliances.	Machinery.
United Kingdom	$ 35,654	$21,862
Other European countries	32,537	27,317
Canada	230,588	149,529
Mexico	120,607	135,026
Cuba	71,955	24,757
Brazil	134,917	7,959
Other South American countries	42,689	13,482
Japan	67,185	168,019
British Oceania	.....	58,516
Other countries	102,185	138,952

Colorado Electric Light Power and Railway Association.

Preparations are all completed for the eighth annual convention of the Colorado Electric Light, Power and Railway Association, which will be held at the Hotel Colorado, Glenwood Springs, September 21-23.

Following is a list of papers which will be read at the meetinges:

"Storage Batteries in Street Railway and Central-Station Work," by T. A. Warfield, general manager of the Colorado Railway Light and Power Company, Trinidad.

"Some Observations on Cultivating Friendly Relations with the Public," by J. M. Connelly of the Denver Gas and Electric Company, Denver.

"Mazda Street Series Lighting," by R. L. Jones, General Electric Company, Denver.

"High and Low-Tension Pole Lines," by J. C. Lawler, New York, N. Y.

"The Place of Rotary Condensers and Induction Generators in Transmission Systems," by H. L. Allen, General Electric Company, Denver.

Cleveland May Have Four-Cent Fares.

Owing to the fact that large deficits have resulted from the three-cent fare on the Cleveland Railway Company, it has been found necessary to discharge 200 track men. The three-cent fare is assured until December 1, but at that time if the surplus is inadequate the rate will be raised to four cents.

August Copper Exports.

Exports of copper for the month of August were 27,976 tons, against 22,839 in August, 1909.

Physical Laboratory of the National Electric Lamp Association.

A Laboratory for Research in Illumination and Electric Lighting.

In the city of Cleveland, Ohio, at the northeast corner of Hough Avenue and Forty-fifth Street, N. E., stands a modest building once used by Charles F. Brush in the early history of the electric lighting industry as an office and laboratory. Today this property is in the hands of the National Electric Lamp Association and is used as a physical laboratory.

The building is constructed of brick and consists of one story and a basement. It is surrounded by lawn and flower gardens, and adjacent to it there are two other buildings which are used for office purposes. A view of the laboratory is given in Fig. 1. Across the street the main building of the Association, containing the Engineering Department and offices, is located, and back of that is the factory building.

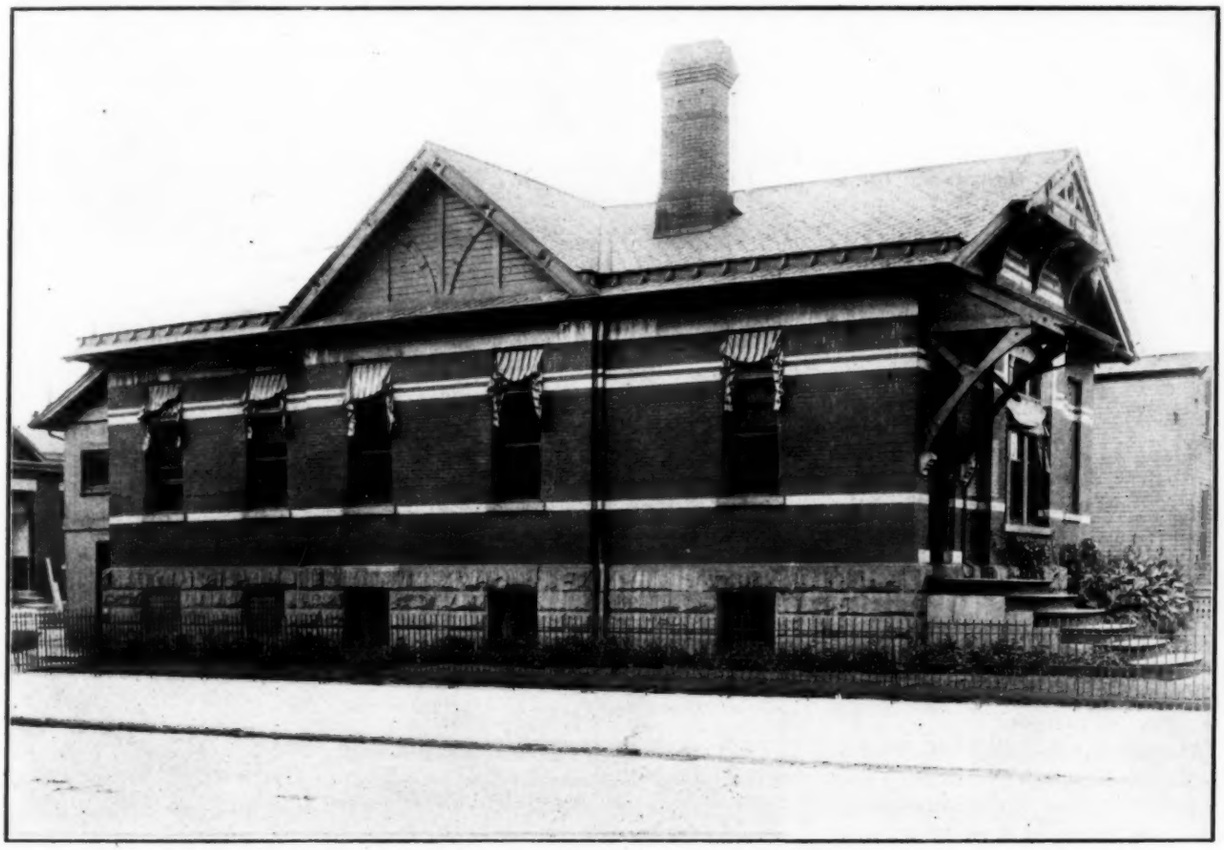


FIG. 1.—THE PHYSICAL LABORATORY.

The Physical Laboratory was established for the purpose of conducting purely scientific research in questions connected with illumination and especially of electric lighting. It is no new thing to have a research laboratory connected with large industrial establishments, but these are usually for the purpose of improving the output or developing new avenues of industrial progress. In contrast to this, the Physical Laboratory of the National Electric Lamp Association has been organized for the purpose of instituting research upon lines which are not directly connected with the manufacturing end of the business, and for the purpose of investigation from a purely scientific standpoint and the determination of the truth and facts connected with this subject for the sake of making those facts known to mankind.

The laboratory was organized in 1908, and as its director was chosen Dr. Edward P. Hyde, who had formerly been in charge of the photometric section of the Bureau of Standards at Washington. The work has already outgrown the building which it has occupied and rooms have been obtained in the larger building of the Engineering Department. It is proposed in the not far distant future to erect a new laboratory entirely devoted to this work and to locate it on the outskirts of the city where there will be less disturbance of a mechanical nature.

The laboratory is organized in three divisions with the idea of investigation along three different lines. The three groups of problems which are to be considered are: (1) those that have to do with the production of luminous energy; (2) those that have to do with the utilization of luminous energy; (3) those that have to do with the effects of luminous and attendant radiation. In the first class come the investigations of the laws of radiation and of the radiating properties of matter. The problems in this class are

purely physical. In the second class are investigations which touch on one side the physical production of light and on the other the physiological effects, and this division of the work will embrace most of the scientific problems peculiar to illuminating engineering. Photometry, the study of the complex phenomena of color and color sensation, and investigation of the absorbing, reflecting and diffusing properties of matter come under this class. In the third class come the investigations of the effects of light and other radiations upon the eye, the skin and upon microscopic organisms.

The work of the first division is being carried on by Dr. C. F. Lorenz, who was formerly connected with the University of Iowa and afterwards studied for the doctor's degree at Johns Hopkins University. He was also recently connected with Queens College at Kingston, Ont. The second division is in charge of Dr. Herbert E. Ives, a graduate of the University of Pennsylvania, and of Johns Hopkins, and formerly assistant physicist in the Bureau of Standards. Dr. Ives is assisted in this work by M. Luckeish, who is a graduate of Ohio State University and was formerly an instructor in the University of Iowa. The third division is in charge of Dr. Percy W. Cobb, who is a graduate of the Case School of Applied Sciences and of Western Reserve University, and is a specialist in physiological research. He was formerly lecturer on the special senses at Western Reserve University. The scientific assistant to the director is F. E. Cady, a graduate of the Massachusetts Institute of Technology, who was formerly assistant physicist at the Bureau of Standards.

A recent acquisition to the staff is H. E. Worthing, who has just completed his studies at the University of Michigan, where he went after taking a course at the University of Iowa.

The instrument shop is in charge of William Würth, a mechanician who has had excellent preparation in the shops of the Société Genevoise in Switzerland, and the Adam Hilger Company in London. A stenographer and a laboratory helper complete the staff of the laboratory.

The rooms of the laboratory are provided with all the facilities necessary for research work of this kind. Alternating and direct current, both from generators and from storage batteries, are available at various voltages. Plug switchboards in each building provide for the distribution of current to any point where it may be required, and in addition to the usual switch outlets there are, at various points on the walls, outlets consisting of sockets mounted on the wall without fixtures and ready for the insertion of a plug with attached cord at any time. Both natural and artificial gas are available and a vacuum system is to be installed. The buildings are heated by hot water, and hot and cold water are available at numerous faucets. The use of double shades of green and black material respectively at the windows, serves to completely exclude outside light when that is necessary. The rooms in the new building have high ceilings and are well lighted. Overhead from wall to wall there are in some of them stretched

FIG. 2.—THE DIRECTOR'S OFFICE.

FIG. 3.—THE LIBRARY.

wires which serve the purpose of supporting loose cord which can be run from one part of the room to another without getting into the way of persons moving about.

In the original laboratory building there are five rooms upon the first floor and three in the basement. On the first floor is the director's office, which is tastefully furnished and illuminated with Mazda lamps and Holophane reflectors supported on fixtures of unique design. Opening into this room is a vault which serves the purpose of a storeroom for valuable apparatus, where it is safe from molestation and from danger of fire. The adjacent room contains the library. Here are received about eighty periodicals, including all the well known journals devoted to electric lighting, physical science, illumination and related subjects, and also a few of interest to the office force of the Association, for the use of this library is not restricted to those connected with the physical laboratory. Bound volumes of the back numbers of these periodicals are being secured as fast as possible, and in addition, all the valuable treatises on the subjects of interest to the men concerned are being accumulated. Adjacent to these are the rooms used for laboratory purposes.

In the basement of the building there are in addition to the laboratory rooms, an instrument shop which is well equipped for all the needs of the laboratory, a vault which has been utilized as a dark room for photographic purposes, and an additional vault which is used as a balance room, and in which an approximately constant temperature can be maintained. The balance is of Ruprecht make, has a capacity of 200 grams and is sensitive to 0.05 milligram. This room has solid brick walls on all sides.

There is now set up in this basement a photometer bench which was designed especially for the purpose. The frame is entirely metal and has its own supports resting directly upon the floor. The ways are perfectly straight and to them may be clamped the supports for screens and photometer. Velvet screens are used between the sources of light and the photometer to exclude extraneous light. The photometer is of the Lummer-Brodhun form and the comparison lamp moves with the photometer and is thus maintained at a constant distance from it. A view of this photometer bench is shown in Fig. 4.

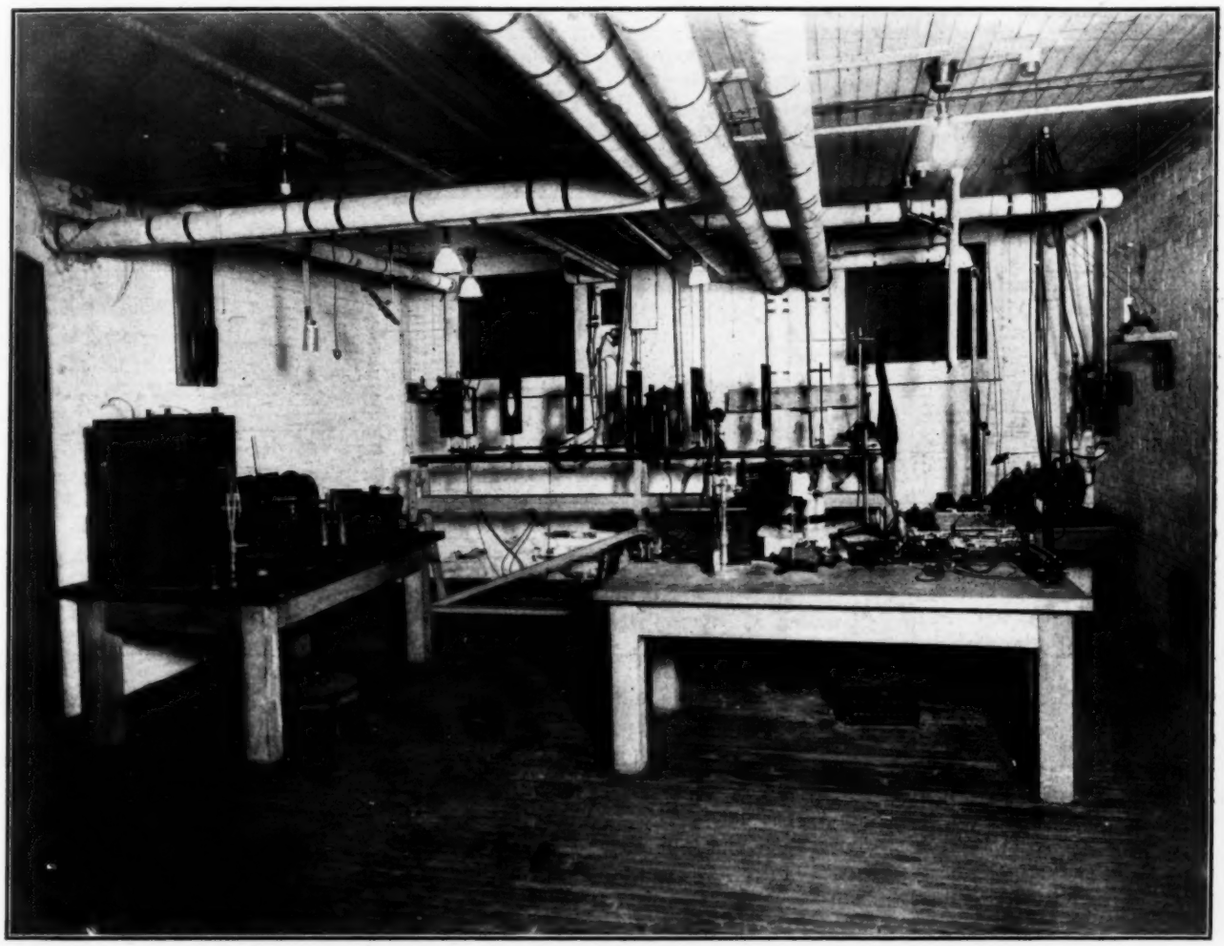


FIG. 4.—OSCILLOGRAPH, PHOTOMETER-BENCH, SPECTROPHOTOMETER AND PUMP.

A set of sector disks has been prepared in the instrument shop for use with this photometer. Each disk has six openings of the same size, varying from two degrees to fifty degrees in the different disks. Cover plates enable the operator to close two or three of the openings in the disk, thus making it possible to secure almost any desired fraction of the 360 degrees. The front surface of each disk has been graved in circles close together, giving a surface which has very little regular

reflection to disturb the observations. Where the slits are very narrow, as for openings of two or five degrees, any irregularity in the edges will make an appreciable error in the exposed area. To obviate this, the edges of the openings are formed by strips of steel which have been ground perfectly plane and screwed in position on the disk.

In the foreground of Fig. 4 can be seen an apparatus which has been set up for spectro-photometric investigations. This is being used in an investigation of the corrections which should be made for impurity of the spectrum lines used in this kind of work. The source investigated is balanced against the comparison source using slits of definite width and securing equalization of illumination by means of a sector disk whose openings vary in length with the radius, as can be seen in Fig. 6. The sector disk may be moved horizontally in front of the slit to secure a balance, and the openings have the form chosen in order to give a more nearly constant percentage change of illumination for a definite linear shift.

FIG. 5.—PERIMETER.

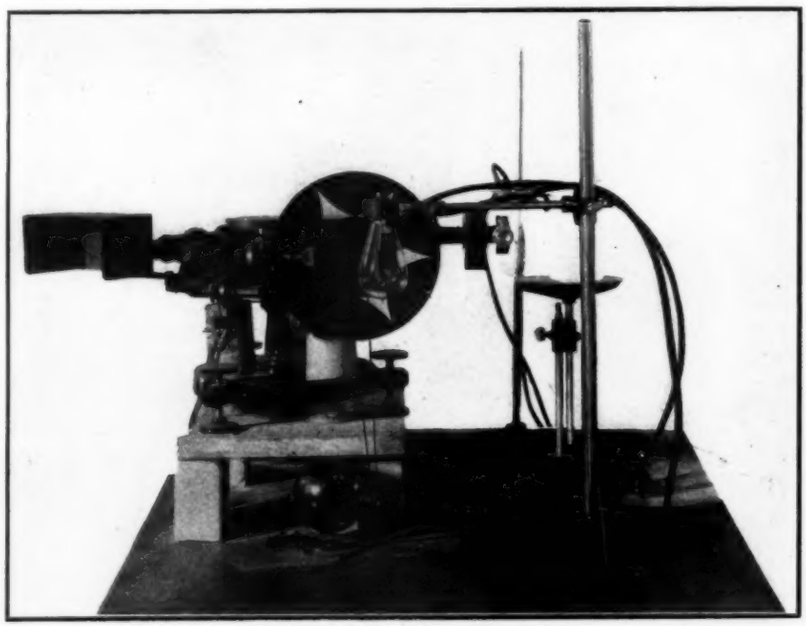


FIG. 6.—SPECTROPHOTOMETER.

For evacuating purposes the laboratory is supplied with a Gaede mercury pump. To this is attached a blower which is utilized for preliminary exhaustion to a pressure of about four millimeters. The mercury pump, which is of the rotary form with sections for entrapping the air, is then put in operation and a six-liter flask attached to a 500-cubic-centimeter gauge can be exhausted to a pressure of 0.004 millimeter of mercury in five minutes and to 0.00001 millimeter in fifteen minutes.

An oscillograph of the Siemens-Blondel form contains two galvanometers and can be used for either visual observation or for making photographic records.

The instrument shop is equipped with a 2-inch Barnes drill-press; a Willey high-speed friction drill-press; a 14-inch Hendey-Norton engine lathe with complete set of attachments; an 8-inch Rivett precision back-geared bench lathe; a No. 1½ Brown and Sharpe universal milling machine with complete attachments; a Willey bench grinder of corundum; a wood-working bench, anvil, blast lamp and other minor accessories. Each machine-tool is separately driven by direct-current electric motor at 110 volts, and is lighted by an individual ceiling-lamp. The shop is shown in Fig. 7.

In the building of the Engineering Department four working rooms, a photographic dark room with special ventilating facilities, and a hall-room containing tools and work-bench, have been secured.

There is one apparatus which is being used for the investigation of color sensibility curves by two different photometric methods. The apparatus is so set up as to combine a flicker photometer with an ordinary equality-of-brightness photometer. Comparisons of different colors with white light are made by different observers by each method, the purpose being to determine which method gives the more correct results and what errors may be involved in each. The differences between the results by the two methods are found to vary in different parts of the spectrum, not only in magnitude but in direction. The spectroscope used has an adjustable slit, which is varied until a balance is obtained. The rapidity of flicker is measured by a Weston tachometer.

Another apparatus is being used to examine the phenomena of phosphorescence and especially of the rate of decay. Sidot-blende is the principal substance which has been used so far in this investigation. It is well known that phosphorescence is excited by radiation in the blue end of the spectrum and that the longer rays in the red end and in the infra-red have the effect of destroying phosphorescence. That is, if this kind of radiation impinges upon a phosphorescing surface the light is extinguished. Whether this extinction requires an appreciable time or takes place instantaneously is one of the problems to be solved. The apparatus includes a photometer for measuring the brightness of the phosphorescent surface, and the variations with time are noted.

A concave grating six feet in focal length and containing 14,438 lines to

the inch, made by Rowland, has been secured.

The work of Dr. Cobb is at present concerned with the investigation of visual acuity in the presence of extraneous light incident at different angles. The apparatus used for this purpose is known as a perimeter and is illustrated in Fig. 6. The test object is placed at the center of the large arc. The illumination is varied by using a small adjustable lamp. The test object consists of two plates, each ruled with a great number of fine parallel lines close together. The lines are too fine to be seen individually by the naked eye, but by turning one of these plates so that the lines form a small angle with respect to the other plate the interference of the light causes a series of dark bands to be visible. The width of these depends upon the angle between the two plates and can be adjusted by the operator so as to give a test object of any desired size.

The glare in the field of vision of the observer is provided by a lamp which is swung around the circumference of the perimeter to different positions, the angular relation of which to the test object can be read off on the graduated frame.

In addition to the apparatus already mentioned, the equipment of the laboratory includes the following: a set of resistance standards, potentiometer, Wheatstone bridge, decade resistance boxes of 100,000 and 10,000 ohms, all made by Otto Wolf of Berlin; type K potentiometer and several galvanometers made by Leeds and Northrup; an assortment of portable electric measuring instruments of the Weston type; a 50-ampere hot-wire ammeter with shunts for 100 and 250 amperes, and a dynamometer also supplied with shunts, both made by Hartmann and Braun; a DuBois-Rubens shielded galvanometer with light and heavy suspensions, various coils of different resistances, two sets of control magnets and a set of shunts; a Zeiss comparator with length standard; a standard Feuss barometer; linear and surface bolometers; a linear thermopile; a set of mercury thermometers reading up to 530 degrees centigrade, made by Haak of Jena; optical pyrometers of the Le Chatelier and the Holborn-Kurlbaum types; thermal couples standardized at the Bureau of Standards; a Schmidt and Haensch, four-part photometer disk; a Siemens & Halske flicker photometer with self-contained motor. A set of standardized incandescent lamps, to be used as photometric standards, has been ordered from the Bureau of Standards. The laboratory also possesses a number of electric furnaces. Two of these are intended as black-body furnaces; one is wound with the usual form of platinum strip and the other consists of a platinum cylinder with magnesia outside and inside. It is used with heavy current and a transformer and was supplied by Hereaus. The black body portion is thirty centimeters long and has an opening one centimeter in diameter. A Feuss spectrometer table intended for investigation of radiation of long wave lengths is supplied with a mirror telescope, a bolometer eye-piece, rock salt and fluorite prisms. This fluorite prism is a very fine specimen 6.5 centimeters on the edge and 3.5 centimeters high and was supplied by Zeiss.

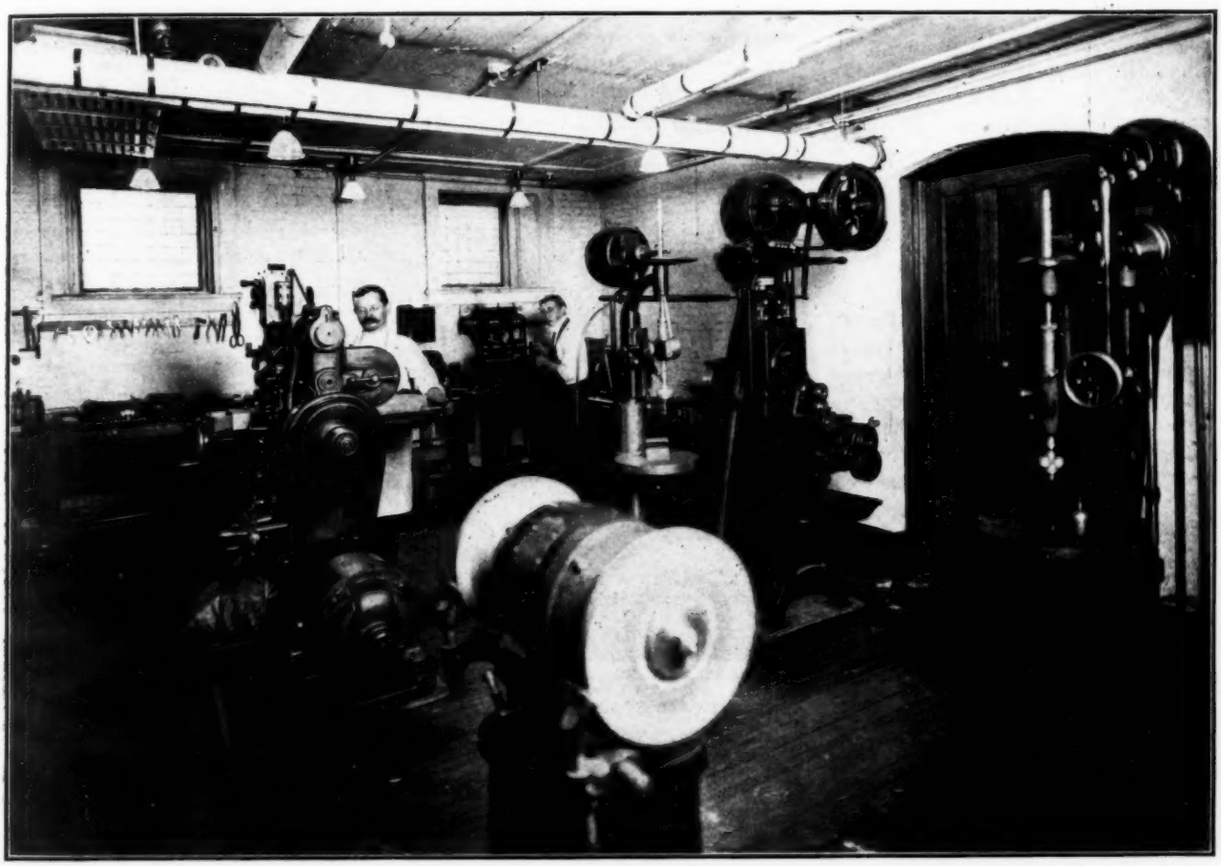


FIG. 7.—INSTRUMENT SHOP.

THE COOPER HEWITT LIGHT TRANSFORMING REFLECTOR.

AN EPOCHAL ADVANCE IN THE SCIENCE OF ILLUMINATION. INTERVIEW WITH DR. PETER COOPER HEWITT, WHO EXPLAINS HIS REMARKABLE METHOD OF SUPPLEMENTING AND COMPLETING THE SPECTRUM OF MERCURY VAPOR AND OTHER LIGHTS BY SUPPLYING DEFICIENT WAVE LENGTHS BY TRANSFORMATION OF LIGHT. THE PHENOMENON OF FLUORESCENCE PRACTICALLY APPLIED.

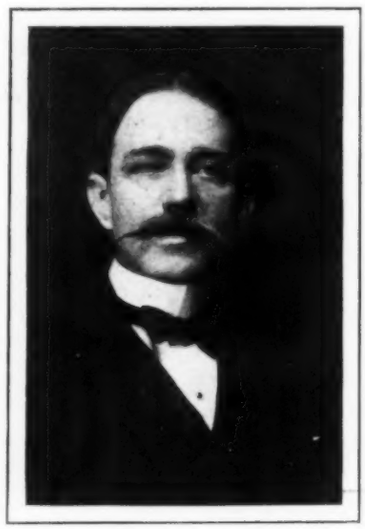
The mercury-vapor light, developed many years ago by the well-known inventor, Dr. Peter Cooper Hewitt, has long been recognized as a light of high efficiency of energy transformation. Its extraordinary richness in the more highly actinic wave lengths, notably blue and violet, has rendered it of great value in photography and photo-engraving; and its low intrinsic brilliancy and great diffusion singularly adapt it to special uses. The Cooper Hewitt lamp is familiar to the electrical public. It consists of one or more glass tubes one inch in diameter and varying from two to five feet in length, highly exhausted of air, but containing mercury vapor, with metallic mercury forming one electrode, and mounted with ingenious starting mechanism and a white enameled trough reflector.

A representative of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN last week interviewed Dr. Hewitt at his laboratory in the Madison Square Garden Tower, New York City, in regard to a marked improvement in the science of illumination which this inventor has recently accomplished. This improvement consists in altering the color of lights of the character of the mercury-vapor light to a close approximation of daylight—completely remedying the greenish glare that has been characteristic of the light hitherto—by using a special reflector to supply red rays, entirely lacking from the original source of radiation.

"How is it possible?" the inventor was asked, "to put into a mercury-vapor light what is not there—the wave-lengths at the red end of the spectrum? Ordinary incandescent lamps have been grouped with mercury-vapor tubes to improve the color of the light by supplying the rays which are not emitted by the present commercial Cooper Hewitt lamp; but how can any external device, such as a reflector, supply these rays?"

"By transforming light by means of the phenomenon of fluorescence, applicable not only to the light from the mercury-vapor, but to the enriching of any light having a deficient spectrum," replied Dr. Hewitt; "that is the answer to your question, in two words."

"It is true," he continued, "that the light emanating from mercury vapor is deficient in certain wave-lengths, particularly in the red region of the spectrum, which are necessary in order to approximate daylight; and although the absence of the red rays has rendered the light 'cool' and restful to the eyes of draftsmen, machinists and certain other workers, the deficiency has, on the other hand, been a stumbling-block to what may be termed its social use, and to uses where the correct rendering of the daylight color-values of fabrics and objects was of importance (as in matching textiles). It is also true that incandescent lamps have been employed as auxiliary light sources, to supplement the Cooper Hewitt light by adding their abundance of red rays. But my present method is totally different, in that it employs a transforming reflector as an auxiliary light source; and this reflector, being excited by the light from my lamp, radiates red rays. The primary light source operates to supply its own deficient wave-lengths by exciting the reflector as a secondary light source. I employ a reflector of fluorescent material, mounted behind the mercury-vapor tube so that the light emitted from the apparatus as a whole consists of the original radiation from the glowing mercury vapor, plus the radiation of transforming wave-lengths from the reflector. An English patent[1] just issued to me is entitled 'Improvements in Light Transforming Reflectors.' The fluorescent reflector, energized by the radiation of wholly different character, so that the resultant illumination from both sources is a close approximation to the ideal white light known as 'daylight'—a rather misleading term, by the way, since daylight is a variable illumination term, both in intensity and quality."



PETER COOPER HEWITT.

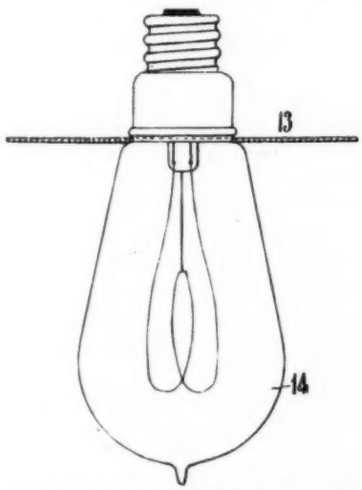
In order to make clear the *modus operandi* of his invention, Dr. Hewitt was asked to go into the general subject of fluorescent materials, and did so substantially as follows:

It is important to distinguish between the action of a mere light-absorbing surface, such as a piece of black cloth, which transforms impinging light waves of all lengths into heat, and true fluorescence. In true fluorescence the transformation is selective from one set of waves of a given range of lengths to another set of waves which have different lengths, generally longer, and which may all be in the visible spectrum, and having the axis of propagation generally at a considerable angle to that of the impinging wave-train. A material which exhibits true fluorescence then becomes itself a secondary light source; and a practically important fluorescent light source would be a highly fluorescent material which, receiving superlatively rich in a group of wave-lengths, *A*, but abnormally deficient in another group, *B*, (present in the spectrum of our ideal illumination, daylight), transforms *A* into *B*. A fluorescent material of this kind, physically arranged to give back its transformed radiant energy with good efficiency, would obviously become a valuable auxiliary to the original source of radiation. Dr. Hewitt's recent work has been to develop such fluorescent materials and use them in reflectors for the mercury-vapor tube; and the result has been that, with the addition of this reflector, the resulting composite light approximates daylight in quality to a remarkable degree.

At this juncture Dr. Hewitt indicated hanging from the ceiling a single mercury-vapor tube in the customary position—slightly inclined to the horizontal—equipped with an over-arching reflec-

1 Patent No. 8,449, dated July 28, 1910.

tor of the light transforming construction, embodying his invention. He pointed out that the reflector consisted of a white surface of kalsomine or enamel, giving diffused reflection, coated with a film of a suitable fluorescent material. This film may consist of transparent material, such as contains cellulose compounds, properly associated with other material and tinted with rhodamine, under certain manipulative precautions. He laid on the table for inspection a varnish-film tinted a peculiar bright red by the dye, and showing a decided fluorescence by a pink tinge at the edges and wrinkles. Upon drawing down the window shade and illuminating the light transforming reflector by the tube, the resultant illumination on colored fabrics spread on the table beneath the light



APPLICATION OF FLUORESCENT REFLECTOR TO CARBON-FILAMENT LAMP.

(samples of silk of many different colors, and wool hangings), gave the effect of daylight. This close resemblance was strikingly evidenced by the fact that the colors of the fabrics under this light were very nearly the same as under daylight, whereas many of the colors (the red, blue and violet shades particularly) were wholly different under the light from an ordinary mercury-vapor tube and under the light from carbon-filament and tungsten lamps.

These tests with colored fabrics, showing the close approximation of the new light to the daylight coming in at a large north window, were confirmed by tests with a spectroscope, in which the effect of the fluorescent reflector was shown in introducing the missing red end of the solar-spectrum bands lacking in the light of the ordinary mercury tube.

It was clear from this demonstration that Dr. Hewitt had succeeded in correcting the deficient color value of the mercury-vapor light, through having constructed a light transformer capable of receiving light as a reflector, transforming it, and emitting it as transformed light in the desired direction, with the above described result.

"How much light is emitted from the reflector?" Dr. Hewitt was asked.

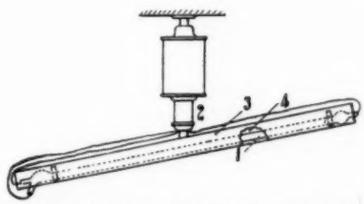
"It varies, but may be about the same amount of red and orange light as given by four standard candles, from each square inch of the reflector," he replied.

The same light transformer is applicable to other light sources which are now in common use, but which have a spectrum which is ill-balanced for many of the purposes for which they are employed.

Dr. Hewitt's inventions comprise means of transforming light waves from a source into light waves of a desired character, and means for emitting the transformed light waves from the transforming material; whereby light of a certain color value is added to the light coming directly from the source, supplementing the latter so that the resultant light has a desired color value. In a former patent[2] he has described means of obtaining a transformation of waves of certain lengths by means of fluorescence, and for mingling the converted waves with those from the source of light. His present invention relates to improvements with respect to increasing the commercial efficiency of the light transformer, and with respect to the producing or increasing of desirable rays (the red rays specifically) by associating the quality of light dispersion with the phenomenon of fluorescence.

This invention has really three sides: First, utilizing the property of fluorescence for transforming wave-lengths of light; second and third, producing highly fluorescent material in usable form—that is, sufficiently durable to be commercially practicable—and causing this material to emit the transformed light efficiently. The materials which Dr. Hewitt has developed consist of substances capable of promoting fluorescence united with suitable carrying materials, and with additional media which promote the fluorescence by modifying the conditions of the carriers; and these materials have been rendered effective in the construction of light-transforming reflectors by applying them to light-dispersing reflecting surfaces, as distinguished from image-reflecting surfaces. The function of light dispersion may, however, be produced by one composite substance, instead of by a light-dispersing body separate from the fluorescent material.

It is interesting to dwell upon this property of fluorescence in the possibilities of usefulness just indicated. In the ordinary incandescent-lamp filament we have an energy trasformation from electrical energy applied at the treminals of the filament into radiant energy, of which we utilize a certain range of the shorter wave-lengths, in other words, electrical energy expended on the filament for the sake of light emitted from the same. The experiments that have culminated in this new system demonstrate that in the expenditure of radiant energy in a fluorescent substance, there to be transformed into radiant energy of another range of wave-lengths, we have also another useful energy transformation and one which is of very great promise in the art of



APPLICATION OF FLUORESCENT REFLECTOR TO MERCURY-VAPOR LAMP.

illumination. The fluorescent substance becomes an energy converter, which, like the lamp filament in the comparison cited, does its work molecularly; and its value consists in reclaiming radiation which is ordinarily objectionable, converting the same into an enrichment of the light which "levels it up" in quality so that it becomes most desirable. By this light transformer it becomes possible to supplement light from a source which may be deemed deficient in some respect, in the easiest way, that is, by reflection.

The Otterspool lightship, located between the southern terminus of the Liverpool dock system and the Garston docks on the River Mersey, in England, will shortly be replaced by an electrically operated fog-bell. The cost of the latter is estimated at $1,430.

2 United States Patent 907,598, dated December 22, 1908, for Method of Producing Colored Light-rays.

THE STATUS OF HETEROCHROMATIC PHOTOMETRY.

BY HERBERT E. IVES.

In the study of every experimental problem there arrives a stage when it is well to ask anew some of the questions which prompted the first experiments. This stage does not necessarily correspond to the solution of the problem as conceived at the start. With the acquisition of knowledge comes fresh light. The problem may take on new aspects; it may be necessary to devote attention to points unknown or considered of small significance at first; the goal originally striven for may be clearly seen to be unattainable. When this stage of fresh light is reached one of the most helpful steps is to ask anew such questions as: "What are the difficulties?" "By what methods is solution apparently possible?" "What may we expect the character of this solution to be, as to its completeness and convenience?" The answers to each of these questions will probably be different from those given when the questions first were asked. With the new answers the efforts of experimenters may take a different path. The solution of the problem may, therefore, be brought much nearer than by continuance along the lines originally planned.

These remarks apply to the present condition of the problem of heterochromatic photometry. In respect to the difficulties involved, the possible methods of solution, and the character of solution to be expected, our knowledge has been much increased since the problem first reached importance. This greater knowledge has complicated and altered matters so that to each question a different answer must be given from that suggested at the start. The difficulties have multiplied with our knowledge of their nature. Several different methods of heterochromatic photometry are available, but their differing criteria complicate rather than simplify the problem. The possibility of one simple and universal solution of the matter is probably less than ever.

In this article our present knowledge of the problem of comparing illuminations of different color is reviewed in order to indicate what in the light of that knowledge we can expect in the way of a practical solution. What we do know will be contrasted with what we still need to know in order to approach such solution as now seems possible. In short, the attempt will be made to outline the experimental work which remains to be carried out, so that we may have a satisfactory basis for measuring the luminous intensity of a carbon lamp, a flame arc, or a Moore tube.

The difficulties in making comparisons of colored lights are partly physiological, partly psychological. To take the latter first, we note that the eye can equate, but it cannot appraise. Now, lights of different color cannot be duly equated. For purposes of description, an illumination may be analyzed into hue or tint, saturation or purity, and luminosity, but this analysis cannot be carried out physically. We cannot filter out the luminosity or brightness and equate it in a photometer with another brightness. Only in the one case where the illuminations are of the same hue and saturation may the brightness be compared, and then it is with a very satisfactory degree of accuracy. As soon as we attempt to equate illuminations of different hue and saturation we face the difficulty of mentally estimating or filtering out the quality of brightness. This mental process is accomplished only with practice, and the result may vary with different individuals or in the same individual at different times. While with small color differences and with practice an observer may acquire a fairly definite criterion, there is no guarantee that this will agree with that of other observers, or that it is the right criterion. The difficulty is akin to comparing the loudness of a sound with the sweetness of a perfume, or to etstimating temperatures with varying degrees of humidity.

The psychological difficulties apply with the greatest force to equality-of-brightness comparisons, so that the principal moral to be drawn from their study is that for heterochromatic photometry some method other than direct comparison should be sought. We shall shortly discuss some other methods.

The physiological difficulties may be listed as the Purkinje effect; the yellow-spot effect; adaptation; fatigue; and finally, color blindness. We need hardly do more than outline these in order to draw our conclusions. Due to the Purkinje phenomenon the relative brightness of different colors varies with the illumination, so that a red may be brighter than a green at high illumination, but darker at low. Due to the yellow-spot effect, a red may be brighter than a green for a small field of view, darker for a large. With the eye adapted to darkness or to light, its power to distinguish colors varies. Continued exposure to light of one color makes the eye relatively less sensitive to that color. These various effects are partly analogus to all physiological processes, partly due to the peculiar construction of the retina, which apparently possesses two sets of seeing organs—rods and cones—irregularly distributed over the field of vision, one set more active at high, the other at low illuminations.

With our present knowledge of the physiological difficulties, one conclusion becomes plain and cannot be too strongly emphasized. Our ultimate solution of the problem must have embodied in it specific statements of the field-size and illumination at which standard comparisons are to be made. Then, if possible, we should be able to calculate from measurements made under one set of conditions what the values would be under another. Certain it is that the relative brightness of two different colors can have no meaning unless we know whether the field of vision is large or small, whether the comparison was made at 0.1 meter-candle or 100 meter-candles.

Adaptation and fatigue probably play a much smaller part in photometry than do field-size and illumination, but they may enter to such an extent that for establishing standards of intensity for different colored illuminations, the observer's physical condition will be of importance. As to color-blindness,it goes without saying that we must never expect color-blind observers to take part in measuring lights of different colors. It is, therefore, sufficient to start with that assumption and consider only the difficulties—great enough—existing for observers of normal vision.

We find, therefore, physiological factors which, by their nature, would appear to affect all color-blindness comparisons, and psychological factors affecting the methods of photometry by equality-of-brightness or direct comparison. The physiological factors cannot be evaded. At best we can only hope to know how to calculate from one set of conditions to another, adopting

one set perhaps as standard. The psychological factors might be evaded by the discovery of other methods of color photometry. Other methods have been developed and will next occupy our attention.

There are at present four methods of heterochromatic photometry. The equality-of-brightness method, as with a Lummer-Brodhun photometer; the flicker photometer; the method by visual acuity; and the methods by critical frequency of flicker. Of these the last three evade the psychological difficulties of the first, for a side by side comparison is not made. But it has been the irony of fate that in seeking methods to avoid the difficulties of direct comparison other perplexing difficulties have been introduced. By all these methods similar results are obtained; colors have approximately the same relative brightness; yet the methods do not exactly agree. More than that, they are differently affected by the physiological factors. Millar, Dow, Stuhr and others who have compared the results given by these methods, find with each the Purkinje effect different and the yellow-spot effect different. The Purkinje effect is apparently less by the method of visual acuity than by equality or brightness; still less, or even absent, with the flicker photometer. The yellow-spot effect is less by the flicker than by the equality-of-brightness photometer. Hence it is now evident that we must not only decide on certain standard physiological conditions for standard comparisons but we are also face to face with the necessity of deciding as to which photometric method shall be employed.

Before doing this one of the largest tasks in the problem of heterochromatic photometry must be faced. We know in a qualitative way that the criteria of the different methods differs, but in a quantitative way our knowledge is very meager. We should have comparisons of the various methods for a large range of illuminations, and for several sizes of photometric field. The same sizes of field and the same illuminations should figure in the test of each method. The importance of this will be realized when it is pointed out that in the light of our present knowledge, different as the results of the different methods are, there is no evidence to show that at high illuminations where the Purkinje effect is small, and with some size of field yet to be found, all these methods may not agree. There exists numerous combinations of field size and illumination, but few of which have been tried out.

A word as to the details of this comparative test. It should be carried out with a fixed scale of color. Comparisons of ruby-bulb and green-bulb lamps, or of mercury arcs and carbon lamps, are hopelessly inadequate to point to a satisfactory solution of the problem. There is but one entirely satisfactory scale of color, namely, the spectrum of a source of known energy distribution. Besides the advantage of its definite character, it has the great advantage that we may reasonably hope ultimately to calculate from results applying to a given spectrum, to the results obtained from any other spectrum. Hence with the so-called sensibility curves of the eye obtained from a normal spectrum by different photometrical methods, at different illuminations and for different field-sizes, we will have a complete comparison of the methods. From this we can hope to calculate our corrections to apply to measurements made by any one method in order to obtain the results that another method, less applicable but more desirable, would give.

Suppose that we have obtained this comparison, the next question that arises is "Which method is best, or right, if there are any right or wrong methods?" This leads to one of the fundamental queries which should precede any investigation relating to exact measurement. What constitutes a satisfactory method of measurement?

The first requisite of a method of measurement is sensibility or definiteness. This is necessary for accuracy and reproducibility. In photometry the one-half per cent obtainable with a Lummer-Brodhun contrast photometer may be taken as representing satisfactory sensibility. The second requisite is that the numbers obtained by the measurement may be treated as arithmetical quantities, *i. e.*, two quantities each measured equal to a third shall measure equal to each other, and the physical sum of two quantities (such as two illuminations) shall measure as the sum of the quantities measured separately. This latter requirement is one present in all physical measurements but is fully taken care of when the method of measurement allows of exact equation of known and unknown. In the measurement of colored lights, however, where true equation is not always possible, for reasons outlined above, this requirement must be perfectly investigated. Unless the method of measurement conforms thereto, it is obvious that illumination measurements with various colored lights must result in confusion. The confusion arising from a defect of this nature would be quite apart from the similar errors which, due to the Purkinje effect, may arise where the working illumination changes greatly from one measurement to another.

A third requirement, applying in particular to photometry, is that the number given to the measured quantity shall correspond to some useful value. Bolometer measurements, for instance, would meet both of the first two requirements, but would give no idea of a light source's value for giving the sensation of brightness, for revealing detail, or motion in the field of vision.

Let us now apply these criteria to the existing methods of heterochromatic photometry. Visual acuity and critical flicker frequency are ruled out at once by the first requirement. By neither method can differences of illumination of less than twenty or thirty per cent be detected. They are fitted not for light measurement, but only for detecting different orders of illumination.

Visual acuity has rather frequently been proposed as a basis for color photometry, on the assumption that we need light principally for seeing detail. While this assumption may or may not be true in general, a clear distinction must be made between using visual acuity as a basis for color photometry, and as a method of color photometry. As a method it would be very unsatisfactory, but, given some other satisfactory method of measurement, it might be possible, if desirable, to determine by numerous tests how the criterion of the latter differs from that of visual acuity. It would then be possible to use visual acuity as a basis, although not as a method. Visual acuity bears somewhat the same relationship to a true method of photometry as the hand bears to the thermometer, as an instrument for determining temperature.

The method of color photometry, by estimation of equality of brightness, is open to criticism on the first requirement. The settings are too indefinite, for the psychological reasons given above. They are not nearly so indefi-

nite as settings by visual acuity, nor so indefinite as to totally bar the method, if no better offers. On the other hand, the flicker photometer possesses in marked degree the quality of sensibility. Owing to its mode of action, the hue difference of the two illuminations compared disappears, leaving only the appearance of flicker, the point of disappearance of which is not a matter of individual judgment in the way that estimation of brightness is in the presence of hue difference. It is in fact as though luminosity were filtered out from hue and saturation. The sensibility of the flicker method with different colored lights compares very favorably with its sensibility for lights of the same color, and with the sensibility of other photometers for lights of the same color.

Taking up the second requirement—the additive quality—we need only consider the equality-of-brightness and flicker-photometer methods, the two others being already ruled out. Curiously enough, both methods have on test shown the sum of several illuminations to measure as the sum of each measured separately. Abney, with a simple shadow photometer and with spectrum colors, found this true for the equality-of-brightness method. Tufts, by measuring a light as a whole and then dispersed into a spectrum, found excellent agreement by the flicker method.

When we add to the results of these tests the undoubted fact that all the methods given yield results which approximately represent the same relative light vaules for the different colors, although they do differ somewhat in their results one from another, we find ourselves seemingly in a position to select the best method of heterochromatic photometry. We find, apparently, the choice narrowed to the methods of equality of brightness and of the flicker photometer, with the advantage in favor of the latter because of superior sensibility.

We are not, however, justified in coming to this conclusion as yet. More careful consideration of the work of Abney and of Tufts, mentioned above, will show that their conclusions cannot be accepted as entirely general. Suppose that there did exist two methods, by each of which we could measure the elements of a light's spectrum against an exactly similar but undispersed standard, and then could measure against this similar standard the light not dispersed into a spectrum. In the latter case we would perform a physical summation. In measuring the undispersed light, or physical summation, against the standard we would compare lights of the same color, and so would obtain the same value by both or any methods of photometry. Suppose we obtained in each case the result that the physical summation and the arithmetical summation of the intensities of the dispersed elements were identical. The physical summations measuring alike, the arithmetical must also be the same. But this can only be true as a general proposition if the methods give like results for each element of the dispersed light. In view of our present knowledge it would appear that the equality-of-brightness and the flicker methods give somewhat different results for different colors. Hence, either under entirely similar conditions the two methods do agree, or else the experience of Abney and Tufts are not universally true.

It is to be noted that these latter experiments were made with very small photometric fields and at unspecified and varying illuminations. It would, therefore, not be surprising if repetition of their work under ordinary conditions should give different results.

Reviewing now the conclusions here drawn, it appears that experimental work in heterochromatic photometry should be directed along two lines. First comes the accumulation of exact data as to relative results given by the available methods under similar conditions. These conditions should include several different field-sizes and a large range of illuminations. The measurements should be made on a fixed scale of color, preferably the spectrum of an illuminant of known energy distribution. Second comes the test of each method for the equality of illuminations, each measured equal to a third, and of the equivalent of the arithmetic and physical summation.

With the completion of these experiments, which the writer is now carrying on, it is hoped to determine, not only the method which possesses most fully the characteristics of a good method of measurement, but also the relation of its criterion to the criteria furnished by other methods.

So much for the lines of experiment now indicated as most likely to lead to some solution of the problem of heterochromatic photometry. It now remains to say something as to the character of the solution we may expect. It is obvious that we ought not to expect simplicity as a characteristic of this forecast solution. Assuming that we have determined the photometer, the field-size, and the illumination with which standard comparisons are to be carried out satisfactorily; these conditions will have to be adhered to always in this kind of photometry. It will not be possible, as in homochromatic photometry, to take illuminations as they occur and then be practically indifferent as to the dimensions and character of the photometer. This, however, does not necessarily mean that practical measurements would themselves have to conform to these conditions. Probably the most practical solution of the difficulty will be the use of working standards of the color of the illuminants measured, or colored glasses to alter the comparison source of the photometer to the color of the other light. These working standards or colored glasses would be calibrated under the standard conditions above specified by observers of tested and normal color vision. In practice, with the use of these working standards or colored glasses, actual photometric comparisons would be carried out with light of one color, hence, in any type of photometer desired and by practically any skilled observer, even if partially color-blind.

A discussion of color blindness has been purposely avoided here. But it is not out of place to remember that color blindness does exist, and that even observers not noticeably color blind differ considerably in their color vision. Hence, the use of colored working standards offers an advantage arising from the fact that these standards or glasses can be calibrated by observers whose color vision conforms most closely to the average. So, while for purposes of calibrating these working standards, a standard photometer and method must be determined, it is open to question whether this photometer and method will be much used outside the laboratory. Will not the standard method of heterochromatic photometry bear much the same relationship to the practical method as the primary flame standard of luminous intensity does to the more convenient incandescent-lamp secondary standard?

It is worth noting in passing that these suggested practical solutions are equivalent to the use of an energy

measuring instrument (*i. e.* a bolometer) in conjunction with a colored screen whose transmission is at each wave-length directly as the visual sensibility of an average eye under the adopted standard conditions.

Some peculiar consequences of the procedure outlined above would be noticed under extreme conditions. If the standard method were by the flicker photometer, for instance, as now seems possible, a measurement made at low intensities, using such working standards, might show a red and a blue illumination equal, which by straight comparison of brightness were clearly not equal, nor would the illuminations be equally efficient from the standpoint of visual acuity.

But such a state of affairs is inevitable from the nature of vision. No one method of heterochromatic photometry will give for all conditions the results of another method. While in this discussion the difficulties and differences of the methods have been emphasized, it must be borne in mind also that under the best working conditions the results of the various methods are probably not greatly different, with any acceptable illuminants. It is, too, not unreasonable to expect that corrections to reduce the results of one method to those of another can be derived for those extreme conditions where the methods most differ and where a different criterion from the standard one is actually called for.

The conclusion, therefore, stands that the present problem is to determine, first, the method of heterochromatic photometry which possesses to the fullest degree the requirements of a good method of measurement; second, the relationship of its criterion to the criteria of the other methods under the varying conditions which affect all such methods.

Having considered what is to be done in order to attain the complete solution of the problem, and the nature of the solution we may expect, a word may be said upon the situation existing until the experimental work above outlined is completed. We are now face to face with the difficulties of making heterochromatic comparisons in the measurement of our most common illuminants. Some temporary solution is therefore demanded. This is perhaps best arrived at by the use of colored glasses or working standards in the manner given above, these to be calibrated for the present by a standard method decided upon more or less arbitrarily. Fortunately, the more common illuminants are not so different in color but that comparisons by the familiar method of equality of brightness can be made in our standard photometers. Fortunately the most generally used precision laboratory photometer—the Lummer-Brodhun contrast photometer—is made with one uniform size of photometric field. Fortunately, too, the usual working illumination in laboratory photometry is sufficiently high to prevent the Purkinje phenomenon from entering to a serious degree. A temporary solution of the problem of calibration might, therefore, be stated to be the use of the Lummer-Brodhun contrast photometer, with a working illumination of five meter-candles, employing for the purpose several observers of normal color vision, as determined by one of the usual tests of color blindness, such as the Holmgren wools. By common adherence to these conditions it should be possible for different laboratories to calibrate, with very good agreement, working standards for the measurement of the more common gas and electric illuminants.

Calibrations of this sort cannot be satisfactorily made to meet all color differences, and the calibrations made will be liable to change when the standard method is developed. Until, however, the standard method of calibration is decided upon, a semi-arbitrary method, of considerable application, is the best that can be had. A method such as that outlined, involving calibrated working standards (practically the method in use at the Bureau of Standards and several European laboratories) is certainly far preferable to the practice of leaving heterochromatic comparisons to be made with all sorts of photometers and all kinds of observers. It is, too, preferable to the other alternative of establishing entirely arbitrary standards of luminous intensity for each color of illuminant. It goes without saying, however, that this semi-arbitrary method of calibration is to be looked upon merely as temporary. As our illuminants increase in number and variety of hue it is to be hoped that the resultant increased difficulty of heterochromatic photometry will be met by the determination of a standard and satisfactory method of measurement. It has been the object of this paper to point out how we may expect to decide upon this method.

ELECTRICAL NOTES FROM GREAT BRITAIN.

BY OUR BRITISH CORRESPONDENT.

The Physical Society of London at its July meeting had before it a paper by the president, Prof. H. L. Callendar, on "The Radiobalance: a Thermoelectric Balance for the Absolute Measurement of Radiation; with Applications to Radium and Its Emanation." The author exhibited at the meeting a disk radiobalance equatorially mounted for solar radiation; a laboratory pattern, with water or steam jackets, for determining the temperature coefficients and for investigating the theory of the instrument; also a cup radiobalance, with which the heat production of radium and its emanation were demonstrated. The last-named instrument is capable of measuring the heat evolved from one milligram of radium to about one part in 1,000.

Dr. W. H. Eccles contributed a paper on the energy relations of certain detectors used in wireless telegraphy. It consisted of a record of the results of an experimental examination into the physical properties of the electrolytic detector, the zincite rectifier, the carborundum rectifier, and a thermoelectric detector consisting of a light contact between graphite and galena. The conditions of the experiments were generally identical with those arising in the ordinary employment of the detectors, and in particular, the quantities of energy, given to the instruments, in the form of electrical oscillations were of the same order in these experiments as in actual practice. Three ways of investigation were followed: The first consisted in applying to the detector an electromotive force which was gradually increased, and measuring the current at each step. The second was to fix the electromotive force at some particular value, to send trains of oscillations of various energy values through the instrument, and to measure the intensity of the sound produced in the telephone on each occasion. The third way was to send trains of constant energy value through the instrument while the steady electromotive force applied to it was varied, and to measure at each step the intensity of the sound produced in the telephone. These modes of investigation gave curves which Dr. Eccles called

respectively the steady-current curve, the power curve, and the sensitiveness curve. The author said that the chief fact brought to light was that the power curves of all the detectors were straight lines, which suggested that all the detectors were fundamentally thermal in their action.

The National Telephone Company's directors and staff, and also the staff of the Post Office, are in the midst of the details connected with that "gigantic industrial operation," as the Postmaster General has termed it, the transference of the National system to the Government, which takes place in December, 1911. Sir George Franklin, chairman of the National company, says that the inventory upon which the company's claim will be founded is about to commence. A staff of about 300, divided into groups, will probably be occupied for more than fifteen months with the preparation of this inventory of the plant. In connection with the transfer, or the scheme of development which the Post Office has in hand as following naturally thereupon, the Post Office has opened a new telephone exchange at Glasgow with accommodation for 10,000 subscribers' lines, to serve the Central District. It occupies the top floors of the Waterloo Street Post Office Building and will be known as the Central Exchange. It will contain the lines connected with the present Post Office Central Exchange, also those connected with the Royal Exchange of the National company, and all future exchange lines in the Central District except those already connected with the Argyle Exchange. The central-battery system has been adopted. The switch room has an area of 10,000 square feet. The switchboard consists of eighty-four operators' positions, on which calls originated by Central subscribers will be dealt with, and thirty-six operators' positions upon which incoming calls from other exchanges to Central will be effected. Under the exchange manager is a staff of supervisors, each taking charge of a group of not more than ten operators. The Central battery consists of twenty Chloride cells of thirty-three plates each. For charging the battery there are two fifty-horsepower motor-generator sets, and the ringing of subscribers' bells is effected by two half-horsepower motors driving alternating-current generators which furnish two amperes at seventy to eighty volts. One of these ringing combinations is driven from the public electricity mains, and the other from the Exchange central battery, as a safeguard against breakdowns. A very full technical description of the Glasgow exchange equipment, which was made and installed by the Pell-Conner Telephone Works, of Salford (General Electric Company, Ltd.), was published in the *Post Office Electrical Engineers' Journal* for January last.

The general manager of the Birkenhead municipal electric tramways reports that he has been able to effect a saving of $11,000 per annum in working expenses through closing down the South End generating station and using it as a substation only, and by reducing the number of cars on the New Ferry route, single-deckers having been converted into double-deckers. The Newcastle-on-Tyne Corporation is going to ask for Parliamentary powers for running trackless-trolley cars for developing certain districts; tramways will be subsequently laid if the results are considered to justify the cost. Weymouth Town Council is considering schemes for running omnibuses (gasoline or electric), railless-trolley cars, or tramways in the town; inclination seems to tend toward tramways, which will cost $135,000. The Bradford Corporation has just issued a very full and interesting report on the several trackless-trolley systems that were inspected by its special deputation which went to different parts of the Continent last November to investigate the question.

The efforts of the Incorporated Municipal Electric Association to secure general support from municipal authorities in connection with the proposed application to Parliament for wiring powers to be granted to all municipal electrical departments, are stirring up a good deal of discussion and some opposition. At Dundee in particular have the local electrical contractors shown fight in defense of their interests from the attacks of municipal trading. They have flatly contradicted some of the statements of the chief electrical engineers with regard to the proportion of additional supply business that they bring to the department. The architects have joined them by protesting, through the Institute of Architects, against the Department's officials going behind the architects endeavoring to persuade owners of buildings to place their electrical work with the Department, promising low-priced contracts if they did so. The engineer has retorted that architects really bring his department very little work, and that owners should decide for themselves whether they will use gas or electricity. He also both said he would not be influenced by any nucleus of electrical contractors, and that if they were anxious to meet him on amicable grounds to arrive at an understanding, he was agreeable. The proposal to support the bill now stands adjourned for a month. Municipal councils in other towns also are not by any means unanimous in supporting interference with the business of the contractor.

A short time ago reference was made in these notes to the improvement that was taking place in the position of the big power companies. The Lancashire Electric Power Company, which for years past has had a difficult task and has recently, under the chairmanship of H. F. Parshall, been rearranging its affairs somewhat, now reports additions to its connected load at the rate of 150 horsepower per month for the past year, with an average of 200 horsepower per customer. The bulk of the business is in supply to cotton mills. It has now contracted for, but not yet connected, a further 1,800 horsepower, largely in connection with colliery installations. The power house is at present only half-loaded; the load-factor is thirty per cent. An expenditure of a further $15,000 on the power house has increased its working capacity and its efficiency, and the coal consumption has been reduced by about twenty per cent, it being now at the rate of 3.35 pounds per kilowatt-hour generated. Many small local authorities in the area have lately transferred their provisional electric lighting orders to the company.

ALBERT H. BRIDGE.

London, August 26, 1910.

The new King Edward's Girls' School, at Handsworth, England, will be entirely lighted and ventilated by electricity, according to the London *Electrical Engineer*. Two eight-horsepower and two five-horsepower motors will be used to drive the electric fans for the air-duct-and-suction system which is to be employed.

LIGHTING THE MORGAN ART GALLERIES AT HARTFORD.

SOME NEW IDEAS AS APPLIED TO INDIRECT LIGHTING.

In the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of August 6 there appeared a general description of the electrical installation in the Morgan Memorial Building, Hartford, Conn. In this article the novel lighting of the art galleries will be considered.

The Morgan Art Galleries are located in the Morgan Memorial Building, which, together with the Colt Building, forms an addition to the Wadsworth Athenæum. This building is a gift from J. Pierpont Morgan and is devoted to the housing and exhibition of works of art and to collections of rare books, natural-history specimens and other objects of instructive interest. The entire second-floor space is given over to picture galleries and to a spacious stair hall, which also is arranged for use as a gallery suitable for hanging large tapestries or similar exhibits.

There are three art galleries in the Morgan Building. Two of these are fifty feet long by twenty-eight feet wide and the third is thirty-four feet long by twenty-seven feet wide. The hall is forty feet by thirty-four feet. A fourth gallery is located in the Colt Building, a gift of the Colt estate; the dimensions of this gallery are thirty-eight feet long by twenty-three feet wide.

No side windows have been provided in any of these galleries, the lighting being accomplished entirely from overhead by means of large skylights. These skylights are about twenty-two feet above the floors, and the ceilings curve away from them on all four sides to form deep coves which meet the side walls tangentially. Above each gallery is a form of high mansard roof, the top of which is covered with tile and copper and the sloping sides are glass. This arrangement of skylight and roof was adopted by the architect, Benjamin W. Morris, of New York, after an extended study of the subject and has proved very effective.

In planning the artificial lighting, it was desired to depart from the usual unsightly, suspended trough reflector with its extremely uneven lighting and distortion of color effects, and to adopt some arrangement which would simulate as closely as possible the effects obtained by daylight, both as to color values and light distribution on the pictures and architectural features of the room, and also to eliminate from the room all electric lamps and fixtures. Some of the considerations which finally led to the use of the method chosen were referred to in the previous article.

In order to accomplish the result, advantage was taken of the space above the skylights and inside the roof struc-

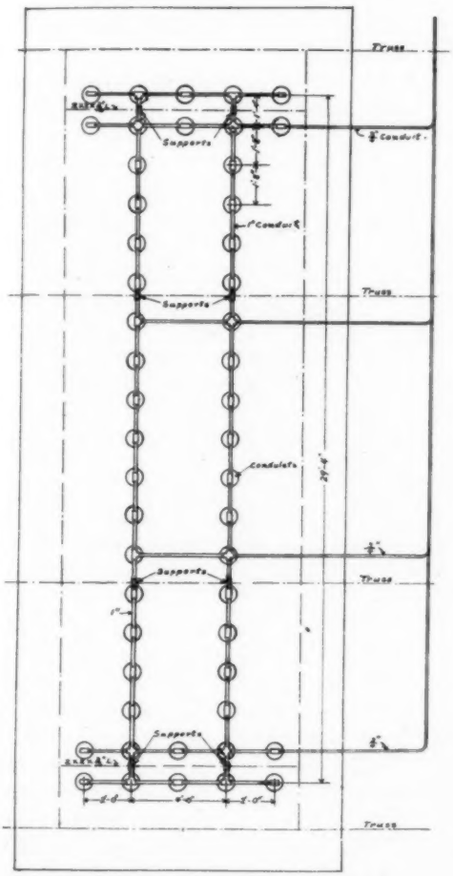


FIG. 1.—ARRANGEMENT OF LIGHTING CIRCUITS IN NORTH AND SOUTH GALLERIES.

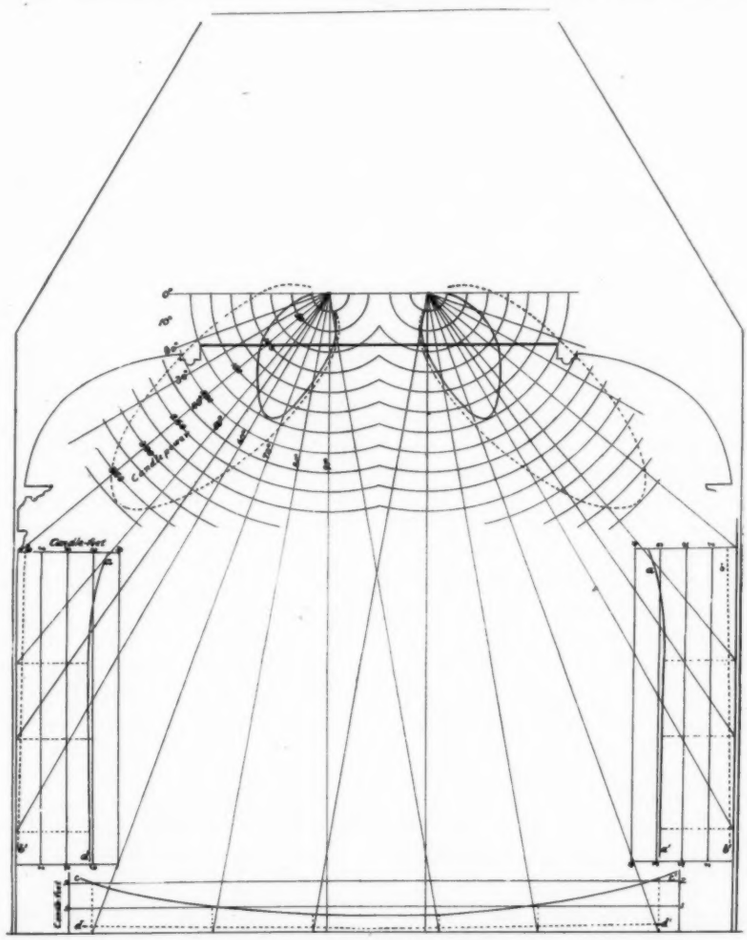


FIG. 2.—TYPICAL LIGHT DISTRIBUTION IN THE PICTURE GALLERIES.
aa'—Normal Illumination on Wall.
bb'—Normal Illumination on Wall from Single Lamp.
cc'—Normal Illumination on Floor.
dd'—Normal Illumination on Floor from Single Lamp.

ture. Within these spaces specially constructed fixtures were hung, the lamps being supported in rows above the skylights and at a uniform distance from the glass. Fig. 1 is a plan of the arrangement of fixtures installed in the Morgan North and South Galleries, which arrangement is typical. It may be seen from the illustration that these fixtures are made up from standard conduit and condulet fittings. The fixtures are supported at several points by rods attached to the roof structure. Each of these supporting rods is equipped with an insulating joint and turnbuckle for adjusting the distance between the lamps and the skylight.

Various forms of lamps, including the arc lamp, the Nernst lamp, the carbon-filament lamp and the tungsten lamp, were considered and from these the tungsten lamp was selected because of its close approximation to daylight in color effect, its steadiness, its adaptability to the conditions, its freedom from complication and frequent need of attention, and its high efficiency. Sixty-watt lamps were selected as the unit, as these are easily handled, readily obtainable and their use requires a sufficient number to give the necessary distribution of the lamp units.

Having decided upon the general scheme of illumination and the lamp unit to be employed, it was then necessary to design the lighting equipment in detail.

In order to secure a type of glass which would serve best to prevent a spotted effect, either on the glass itself when viewed from below, or on the walls, and which also would not absorb an undue amount of light, tests were made on a number of samples submitted by the manufacturers, and, as the result of these tests, a rough wire glass, sand-blasted only on one side, was selected. As installed, the sand-blast surface is on the under side. This screen was found to be very effective, even with the lamps supported at a distance of two feet above the glass, there being a total absence of spotting on the walls and very little on the glass itself.

Next to the determination of the total number of lamps required for properly lighting the room, and perhaps of equal or greater importance, was the proper directing of the light.

In previous installations along similar lines to this no apparent attempt has been made to direct the light except, perhaps, downward upon the skylight glass, with the result that the floor has been flooded with light at the expense of the walls. For certain installations, such as railroad-station waiting-rooms, auditoriums and rooms generally where a downward light over the entire floor area is desirable, this arrangement is satisfactory, but where the objects to be illuminated are entirely upon the walls, as was the case in this installation, any excess of light thrown upon the floor is not only a waste, but worst still, has the effect, both by comparison and by contracting the pupils of the observer's eyes, of producing a sense of dimness in the very place where good lighting is required.

After a search and some experimenting among the several types of reflectors available, a concentrating form of opaque, mirror-lined reflector of the so-called "double-angle" type was selected. This includes, as a part of the reflector, a lamp socket with a trunnion joint interposed between the socket body and the nipple.

The selection of the reflector, the angle at which it was inclined and also the number and arrangement of the lamps were determined by calculations based upon the candlepower curves of the lamps with their reflectors and the absorption and distortion of this light distribution by the glass screen, the selections being made with the object of obtaining as nearly uniform illumination as possible on the side walls, combined with the minimum lighting of the floor.

These results were derived from the curves shown in Fig. 2, the illumination measured in candle-feet being indicated for both side walls and floor. These curves are plotted for an individual pair of lamps and, by combining these results with the results of calculations showing the number of lamps effective at each point and the average candlepower of each of these lamps in the direction of the point under consideration, the final curves showing total illumination were obtained.

Fifty sixty-watt lamps were installed over each of the two large galleries, thirty being used over the West Gallery, thirty-four over the Colt Gallery and forty over the Stair Hall.

It will be seen from the curves that the resultant illumination on the side walls, taken over any vertical strip, was very uniform and was of such a value as to give excellent results, the candle-feet ranging from a minimum of 2.8 to a maximum of 3.5.

In addition, the trunnion-joint arrangement, with which each reflector is equipped, makes it possible to concentrate a number of the lamps on any one picture or group of pictures which it may be desired to place in particular prominence and this flexibility removes the objection which might possibly be raised to this form of lighting as compared with the use of individual lamp groups placed in reflectors just above the pictures to be lighted.

In the horizontal direction a uniform lighting effect was obtained by so spacing the lamps as to cause the spots of light, which each lamp individually would tend to produce, to overlap, which condition, combined with the diffusing effect of the glass screen, produced a blanket of light of great uniformity. In this way also the effect of a single lamp was multiplied as indicated in Fig. 2.

The selection of the distance between the lamps and the screen also had much to do with this smoothing out of the irregularities in the light. Placing them at too great a distance would have the effect of throwing an excess of light on the floors and into the unoccupied roof spaces, while if too near the glass, the diffusing effect of the screen would not be sufficient to eliminate the spotting effect.

The result is analogous to the effect of the sun's light shining through a film of clouds of sufficient density to obscure that highly concentrated source of light, without, however, materially reducing the total amount of light. The similarity between the effects produced by artificial means and by daylight was attested to, by one who saw the completed installation in operation for the first time on the occasion of the formal presentation of the building, in the following words: "We realized ——, the day of the opening, the delight of passing from daylight to evening with hardly a perceptible change in the quality of the light." The accompanying view, Fig. 3, gives some idea of the uniformity of the lighting.

The principle thus employed and which is believed to be new in its ap-

plication to this class of lighting, and possibly to lighting in general, has been designated by its designer as "directed indirect illumination."

The artificial illumination of these galleries was planned by and executed under the direction of Putnam A. Bates, of New York City, who acted as consulting and designing engineer for the entire electrical, heating and ventilating equipments of the building.

Reflecting Powers of Metals.

A continuation of the previous work of the author upon this subject is reported by W. W. Coblentz in *The Journal of the Franklin Institute* for September . The reflecting powers of several additional metals, including tungsten, tantalum, and molybdenum, have been examined, and it is shown that in common with all the other pure metals previously examined, these metals have a low reflectivity in the visible spectrum, but rapidly increasing values in the infra-red. The reflectivity curves of tungsten and of molybdenum are so nearly alike that from a consideration of their optical properties there is no great choice in the use of these two metals in incandescent lamps. Since molybdenum is tough and tungsten is brittle, it remains to be seen whether other physical difficulties can be overcome in the former metal, to enable its introduction as an illuminant.

The high efficiency of metal-filament lamps is due to their low reflectivity in the visible spectrum and high reflectivity in the infra-red. In tungsten this results in an emissivity of nearly fifty per cent of that of an ideal radiator in the visible spectrum, while in the infra-red the emissivity is less than ten per cent.

The ideal solid illuminant giving a high luminous efficiency must fulfil the conditions of a high operating temperature, a high reflectivity (hence low emissivity) in the infra-red, and a low reflectivity in the visible spectrum. Tungsten and molybdenum fulfil these conditions better than any other known metal. It was impossible to obtain a suitable sample of osmium, but curves are given for graphite, tellurium, silicon, and a number of metals.

FIG. 3.—ARTIFICIAL LIGHTING IN THE MORGAN ART GALLERIES.

Special Tungsten Street Lighting in Chicago.

The installation of special tungsten clusters along the outlying business streets of Chicago is progressing steadily. There has just been completed the installation of fifty-one posts on West Chicago Avenue between Ashland and Western Avenues and fifty posts on East Thirty-first Street between Michigan and South Park Avenues. These posts carry four tungsten lamps each and are installed, lighted and maintained by the Commonwealth Edison Company. Over 1,000 of these posts have now been placed along Chicago streets in front of the premises of such merchants as have agreed to pay the low rental charge.

Indirect Illumination with High-candlepower Tungsten Lamps.

The indirect lighting system in which the source of light is entirely screened from view is regarded by many as the ideal method of lighting for interiors, because it is generally conceded to be the most comfortable to the eye. Formerly it was thought that the indirect lighting system was a luxury, but over a year ago Dr. Berthold Monasch showed in an article in the *Elektrotechnische Zeitschrift* that the indirect system employing direct-current open arc lamps with pure carbon electrodes was more economical than the direct system with carbon-filament incandescent lamps. In two articles in the same journal last month he discussed the relative economy of the indirect system equipped with high-candlepower tungsten lamps as compared with other lamps.

The author does not regard the use of flaming arc lamps as practicable for indirect lighting, because both the gaseous and ashy dust products of combustion of the electrodes as well as any flickering are objectionable in interior lighting. Likewise inclosed arcs are not considered suitable because they are the least efficient form of arc lamp. Of the various types of arc lamps the open arc with pure carbon electrodes is the most suitable. Of such lamps the direct-current open arc with inverted carbons (positive below, negative above) is more efficient than the alternating-current open arc. Therefore the latter is not considered practicable, nor are the mercury arc and quartz lamps suitable for indirect lighting because of their peculiar color.

A series of illumination tests was undertaken, first with a 400-hefner tungsten lamp, mounted as shown in Fig. 1. The inside of the metallic reflector was coated with a highly reflecting white surface. The test plane was placed horizontally in each case at a height of one meter above the floor. The walls and ceiling were of a light yellowish white color, but had not been tinted since twenty-five months before the tests; therefore they were far from being in the most favorable condition for indirect illumination. The distance between the light unit and the ceiling was varied from thirty-five to eighty centimeters, and finally forty-five centimeters was chosen as giving the greatest light flux on the test plane.

Tests were then made with 600, 400

and 200-hefner tungsten lamps mounted successively in the same reflector; a 100-hefner lamp was also tried but in a smaller reflector. The average illumination was 58.8, 44.4, 18.8 and 11.2 lux, respectively. The efficiency expressed in watts per lux per square meter was 0.297, 0.269, 0.318 and 0.274 respectively. The ratio of maximum to minimum illumination, thus showing the uniformity attained, was 3.84, 3.27, 3.7 and 5.0 respectively. In these tests the lamps were supplied with fifty-cycle current.

An alternating-current pure-carbon open-arc lamp was then similarly mounted and tested. Its average illumination was 40.2 lux; its efficiency 0.339 watt per lux per square meter; the ratio of the maximum to the minimum illumination was 3.95. The tungsten lamp corresponding closest to its candlepower was the 400-hefner lamp; as this tungsten lamp was more efficient and satisfactory in every way, the alternating-current open-arc was not considered further.

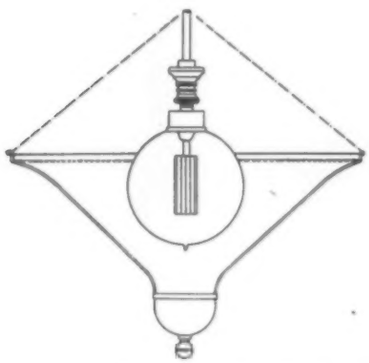


FIG. 1.—FIXTURE FOR INDIRECT TUNGSTEN LIGHTING.

From results previously obtained by Dr. L. Bloch it had been shown that the direct-current open-arc lamp using pure carbons inverted gave a higher efficiency for indirect lighting than the similar lamp with the carbons normally placed and that the efficiency of the latter practically agreed with that just found for the tungsten lamps. Therefore comparative tests were made with the tungsten lamp and the inverted-carbon direct-current open-arc lamp, the results being as follows: Average illumination 32.97 and 36.33 lux, respectively; efficiency 0.286 and 0.195 watt per lux per square meter, respectively; ratio of maximum to minimum illumination 3.35 and 4.38, respectively. Thus, while the average illumination with the inverted open arc was ten per cent higher than that of the tungsten lamp, the latter gave a much more uniform illumination, so that the one advantage counterbalanced the other and the two types of lamps may be regarded as on a parity.

To compare the ultimate economy of these two lamps it was assumed that the life of the tungsten lamp was 1,000 hours, so this time was taken as the basis of comparison. For the arc lamp the total cost of the carbons is $5.00; the cost of trimming is sixty cents; the combined cost of carbons and trimming (under conditions prevailing in Germany) is thus $5.60. The corresponding expense of the tungsten lamp is only one renewal costing $4.88 for the 600-hefner lamp. The power consumption for the arc lamp is 550 watts, for the tungsten lamp 660 watts. For energy costs below seven-tenths of a cent per kilowatt-hour there is therefore no appreciable saving in using the inverted open-arc lamp. With energy costing 4.7 cents per kilowatt-hour, the arc lamp results in an economy of $4.50 in 1,000 hours; with energy at 9.5 cents per kilowatt-hour, the saving would be $9.75. Although an energy charge of only seven-tenths of a cent per unit is very low, the author contends that it is frequently attained in Germany. Where the energy costs more than this, an exact cost analysis should be made in each case under the prevailing conditions. It will often be found that the economy of the inverted open-arc lamp will be so slight that the steadiness of the light, freedom from noise and odor, and the elimination of the disturbance from frequent trimming attained by the use of the tungsten lamp will more than compensate and therefore make the tungsten lamp the most practical lamp for indirect lighting in nearly all cases.

The author then made a comparative study of indirect tungsten lighting and direct tungsten lighting, using in the latter case clear bulbs, frosted bulbs and finally clear lamps surrounded by a diffusing shade or globe. The last type of lighting (with diffusing globes) he calls semi-indirect lighting; in this he used the fixture shown in Fig. 2 and one similar. The shade *B* was of opal glass four millimeters thick. The efficiency of the lighting when this shade was used was but slightly higher than that of complete indirect lighting, but the illumination was not nearly as uniform. In the case of direct lighting with frosted lamps the efficiency was practically the same as with diffusing shades, but the distribution was more uniform. Direct lighting with clear lamps gave the highest efficiency and nearly the same uniformity as indirect lighting; it was accompanied, of course, with considerable glare.

Tests were also made with a five-ampere direct-current so-called "economy" arc lamp provided with a truncated pyramidal milk-glass reflector. This showed poorer efficiency, however, than any of the types just referred to. A final comparison was made with the Moore vacuum-tube system of lighting, and according to the author's calculations its efficiency was still lower than that of the preceding arc lamp.

A summary of the efficiencies found by the author for the various systems of interior lighting considered is given as follows, the efficiency being in each case expressed in watts per lux per square meter:

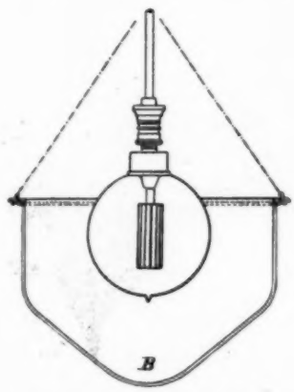


FIG. 2.—FIXTURE WITH GLASS DIFFUSING SHADE.

Indirect lighting—direct-current open-arc lamp with normally placed pure carbons, 0.188 to 0.303; same type of lamp with positive carbon below, 0.136 to 0.220; alternating-current open-arc lamp, 0.339; tungsten lamps (direct or alternating current), 0.259 to 0.318.

Semi-indirect lighting (using diffusing globes or shades)—direct-current open-arc lamp with normally placed pure carbons, 0.15 to 0.35; direct-current inclosed "economy" arc lamps, 0.367; tungsten lamps, 0.225 to 0.260.

Direct lighting—direct-current open-arc lamp, 0.15 to 0.30; carbon-filament incandescent lamp, 0.5 to 1.2; clear tungsten lamp, 0.15 to 0.175; frosted tungsten lamp, 0.22 to 0.25; Moore alternating-current vacuum tube, 0.445.

In conclusion the author points out that it is possible in nearly all problems of indirect illumination to develop a formula suitable to the conditions of the case so that the calculations may be simplified by considering a point-source of light at the ceiling above the actual source and equivalent to it in lighting value. Where the ceiling and walls are very dark or where the room is very high, Dr. Monasch suggests that it is still possible to use indirect tungsten lighting by placing a slightly conical reflector over the lighting fixture.

English Developments in Generating Power from the Waste Heat.

Some important extensions have recently taken place at the exhaust steam generating station installed at Messrs. Samuelson's Ironworks at Newport, Middlesborough, England, says the London *Electrical Review*. This station, which belongs to the Waste Heat and Gas Electrical Generating Stations, Ltd., utilizes the exhaust steam from blast-furnace blowing engines, and the electrical power produced is partly used on the spot and partly supplied to the network of the Cleveland and Durham Electric Power Company. The new plant consists of two 1,250-kilowatt, three-phase forty-cycle, 6,000 to 6,600-volt turbo-alternator sets, of Westinghouse make, running at 2,400 revolutions per minute. The turbines are of the double-flow reaction type, in which the steam is expanded from atmospheric pressure to condenser pressure. The centrifugal governor is driven direct through a worm wheel and shaft from the turbine spindle, and controls direct the valve admitting steam to the turbine. Two safety devices are supplied for shutting off the turbine in case the speed becomes excessive. One opens up the condenser to the atmosphere and destroys the vacuum while the other closes the governor valves. The condensers are beneath the turbines, and the air pumps are of the Westinghouse-Leblanc type, sealed with water, the pump itself being driven by a squirrel-cage motor direct-connected with the air-pump shaft. The condensed water is returned to the works. The hot-water lift pump is also driven by a squirrel-cage induction motor. The electric generators are of two-pole, revolving-laminated-field type, giving a continuous output of 1,875 kilowatt-amperes.

THE QUARTZ-TUBE MERCURY-ARC LAMP.

BY J. G. ZIMMERMAN.

Although this new lamp has gained considerable prominence in Europe, particularly in Germany, its use in this country is practically unknown. The older type, namely, the Cooper Hewitt lamp, has, however, come into quite extensive use. Where the color of the light is not material and where a diffused soft light is required to avoid sharp contrasts, it is particularly suitable. The high efficiency also has a good deal to do with its use. But the color of the rays it generates prevents its general use where color values must be shown. On this account and because of its high efficiency a great amount of work has been expended toward its improvement. But it was not until the commercial production of articles in transparent fused quartz that any practical headway was made.

The idea of introducing foreign materials into the mercury, with the hope that the spectrum of each such added material would, at the working temperature of the arc, add the missing rays to the blue of the mercury arc, has proven but partially successful. The fact that when impurities are added to the mercury the smooth action of the arc is interfered with has prevented results from being obtained. Likewise, the fact that different materials and elements give out light rays at different temperatures prevents the possible use of but a few of them. The mercury arc, as it exists in the Cooper Hewitt lamp, is at a comparatively low temperature.

Since mercury, like many other elements, gives out a "wider" spectrum with increased temperature, attempts have been made to raise the arc temperature without affecting the containing tube. But as glass was, up to the introduction of quartz in fused form, the only available material possessing the necessary properties of strength, transparency and heat resistance combined, these attempts proved futile. Glass is but a fused mass of quartz and other materials, and it is evident that as the proportion of quartz is increased the higher is the melting point. Ordinary methods of working glass prove unsuccessful on this account when the melting point goes beyond something like 350 degrees centigrade. Quartz melts at somewhere near 1,500 degrees centigrade, and as its melting and vaporizing points are very close together the process of manufacturing it into articles is very difficult. This accounts for the high price of such wares. Another difficulty in the use of glass as a container for the arc lies in the inability of glass to withstand great differences of temperature applied suddenly. The arc on being drawn in a tube subjects the same to very intense temperature changes. Quartz, however, will withstand the greatest differences which can be produced without difficulty, because of its extremely low coefficient of expansion.

In order to concentrate the energy of the electric current in the mercury arc that its temperature may be raised, the size of the containing tube must be greatly reduced. The new form of lamp has an arc length of something less than three inches, while the bore of the tube is about one-half inch. This is a great improvement over the older type with its tube approximately a yard long. But with increased concentration of energy the difficulties of properly radiating the heat so as to maintain the mercury terminals in the liquid state become apparent. This has been overcome in an ingenious construction which will be described later. The temperature of the Cooper Hewitt arc has been found not to exceed 300 degrees centigrade, while that of the quartz lamp has been estimated to go above 6,000 degrees centigrade. This temperature is almost inconceivable, but if we investigate, it will appear to be reasonable. Experiments with the former lamp have demonstrated that the temperature of the arc from the center of the tube bore to the outer walls is graduated with the highest temperature at the center. The walls of the tube act as radiators for the heat in the vapor next to them and with a lowered temperature the vapor has a reduced conductivity for the electric current. This concentrates the current in the center, with an increase in temperature resulting there, and a further tendency to exaggerate this condition. It is the same with the quartz lamp, only the temperature of the walls is approximately 1,400 degrees centigrade, instead of about 150 degrees centigrade.

With such temperatures it is to be

expected that the spectrum of the light emitted is more nearly the desired "daylight spectrum." It has been found that the visible spectrum, with the exception of the red rays, is present in the light, and in appearance it is what is generally termed white. The light, therefore, is much more suitable for general use than is that of the Cooper Hewitt lamp. In addition to the increased light quality the efficiency is approximately 0.25 watt per candle. This compares favorably with that of the flaming arc lamps and far exceeds that of other sources of artificial light as yet put into practical form. The compactness of the lamp is also one of its advantages.

In order to more fully understand the operation of the quartz-tube mercury-arc lamp reference to the illustrations will be useful. Fig. 1 shows the general appearance of the lamp, which is similar to the Nernst or inclosed-arc lamps. Its use is possible wherever the other types mentioned can be used. Fig. 2 shows a section of the lamp; Fig. 3, the diagram of connections, and Fig. 4, the performance

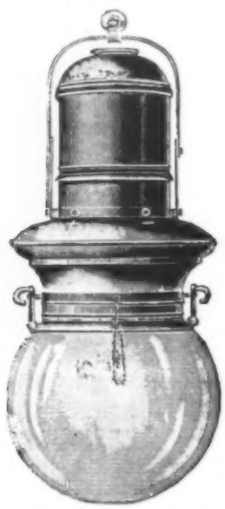


FIG. 1.—EXTERIOR VIEW OF LAMP.

curves. In Fig. 5 are shown the candlepower readings in a plane at forty-five degrees to the vertical plane passing through the axis of the arc tube.

The quartz tube consists of a short tube *a* (Fig. 3), joining two other tubes of about the same bore and placed at right angles to them. At the center of each end tube (*b*, *b'*) the terminal tubes (*t*, *t'*) are attached. On each of the projecting ends of tubes (*b*, *b'*) are attached copper fins with their arrangement in the form of hairlike pins. As mentioned before, the temperature of the arc in the tube *a* is very high, and this heat is in part conducted away by the mercury which fills the tubes *b*, *b'*. In order to keep this mercury cooled, the projecting fins are attached to the tubes *b*, *b'*. The length of the tubes

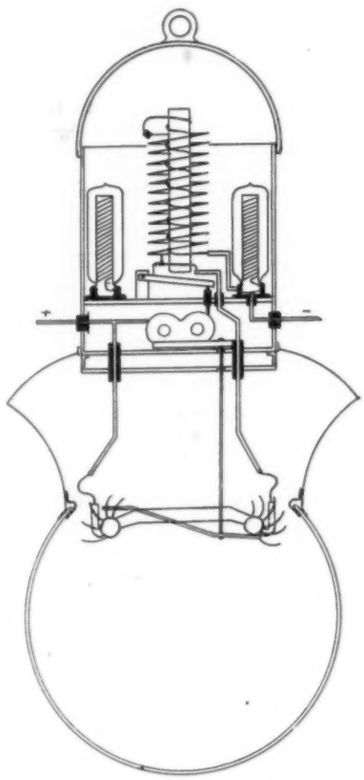


FIG. 2.—LONGITUDINAL SECTION.

(*b*, *b'*) is such as to give the entire tube the appearance of the letter **H** lying in a horizontal plane. At *t*, *t'*, the leads enter, and instead of being of platinum are of nickel-steel. This substitution is necessary, inasmuch as the coefficient of quartz is below that of platinum and is almost the same as that of the alloyed steel.

Like the Nernst lamp glower, the arc has a tendency to increase in temperature and therefore in current consumption until something gives way. On this account ballasts very similar to those of the Nernst lamp are required. These are represented in Fig. 3 by *I*, *I*, and in Fig. 2 they may be seen in the top enclosure as screw-socket tubes. These tubes contain the fine iron wire resistors, which have the property of increasing rapidly in resistance when the current raises them to a dull red heat. This resistance is so adjusted that it effectually stops an excess of current from flowing. But in addition to this ballast is another adjustable resistance, which makes it possible to adjust the lamp for any small variations of line pressure such as for a 110-volt or 120-volt circuit. In operation the lamp is also similar to the Nernst, but the starting is slightly different. Here it is necessary to strike an arc, where in the other lamp a heater is supplied to raise the temperature of the glower to the conducting point.

It will be noted that the tube *a* is raised above the end tubes *b*, *b'*. This causes the mercury to separate at the ends of *a*. When the pressure is thrown on the lamp the tipping magnet (*o*) attracts the armature (*e*), and through the connecting rod (*g*) causes the tube to rock so that the positive end is raised and the negative lowered. This allows the mercury in *b'* to run over through *a* to *b*, and complete the circuit of the lamp. As soon as this is established the magnet *M* is excited and attracts the armature *c*, which in turn breaks the circuit controlling *o*. This allows the tube *a* to resume its normal position and at the same time breaks the mercury circuit in *a* and

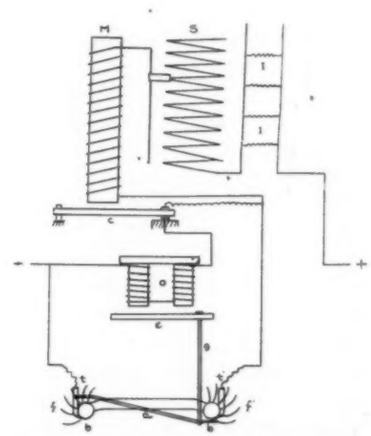


FIG. 3.—DIAGRAM OF CONNECTIONS.

starts the arc. All the current which flows in the lamp must be conducted by the ballast resistances (*I*, *I*), and so long as current flows in the main circuit no current will flow in *o*.

The regulation of the current in the arc is controlled in three ways, namely, by the radiation of heat from the copper fins, by the ballast resistance and by the mercury resistance. The adjusting resistance (*S*) is of a material having a negligible temperature

coefficient and therefore has no effect. Once the arc is established, the temperature of the same gradually increases. This reduces its resistance and tends to increase the current. The ballast being of very fine wire, is almost instantaneous in action, and its temperature is at once raised to the dull red, which chokes off current to a great extent. The mercury contained in the tubes *b*, *b'* is of considerable volume and therefore changes gradually the temperature, increasing with time. Its action is therefore sluggish and tends to prevent sudden changes of current. When the arc is fully established the adjustment of the various resistances becomes normal and all tend to keep the current constant. The radiating fins play a very important part in the regulation of the mercury resistance, inasmuch as they are very sensitive to temperature changes and radiate accordingly. Hence it is necessary to prevent drafts from striking them, and an inclosing globe is necessary. By studying the curves shown in Fig. 4 the operation of the lamp can readily be followed.

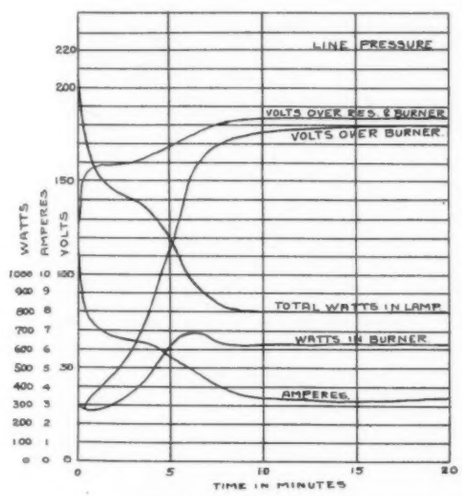


FIG. 4.—PERFORMANCE CURVES.

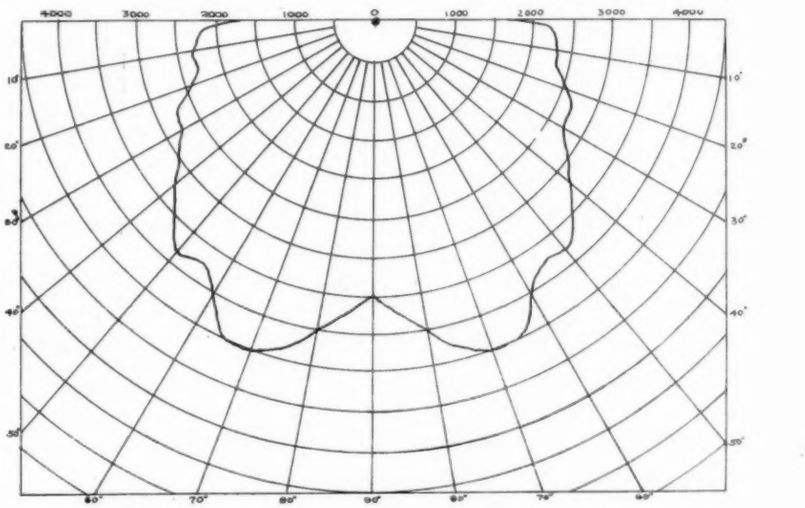


FIG. 5.—CANDLEPOWER DISTRIBUTION CURVE.

The curves show that a momentary rush of current of three times normal value follows the closing of the circuit. For a large number of lamps thrown on at once this would be serious. It takes something like seven to eight minutes before steady normal operation is established, which would prove unsatisfactory where it is necessary to have the full intensity of light at once. However, where a large arc is required this is not so necessary. In fact, nearly all arc lamps have an unsteady action for several minutes after starting.

In addition to the visible rays given out by this lamp the ultraviolet rays are also present in considerable quantity. The dangerous effect of these rays on the eyes has been shown in many instances where experimenters have nearly lost their sight. Quartz has the property of transmitting these rays without absorption, while ordinary glass absorbs them entirely. It is therefore necessary to inclose the tube in a globe of glass. Thus, the globe serves a double purpose.

The candlepower of the lamp varies with the angle it is viewed from. The shape of the glower is such that the end tubes interfere somewhat with the light rays as the angle approaches the horizontal. But the downward and upward light is very uniform, and therefore the location of the lamp is best when above or provided with upward reflectors for indirect lighting.

The cost of the quartz tube is relatively high, being about $7.00 in Germany. However, the manufacturers will allow a credit of about $5.00 for its return on a new lamp. Hence the cost is not so great as is at first apparent. The life of the lamp should be at least 2,000 hours, and is so guaranteed. In fact, there seems to be no reason why its life should not be greater, as there is nothing to wear out. Actual results have shown that the lamp will burn over 6,000 hours without losing any of its properties.

The future of this lamp would seem to be good and the prospects for its improvement ought to be excellent. Its combination with other lamps gives an ideal light, for most of the commercial lamps are lacking in blue rays. Experiments have been made to show that an artificial "daylight" may be produced in this manner. But the ideal lamp must possess all of the desired features in one, which will make it applicable to all purposes without regulating or adjusting one part to the other. The high temperature of the mercury vapor would seem to offer a possible means for heating a glower placed in its neighborhood in the tube. This glower need not carry any current, but merely act as a light source due to its high temperature. Future development will, it seems, be along this line.

Decorative Tungsten Lighting in Buffalo.

An attractive special street-lighting installation with tungsten clusters has been completed along Genesee Street between Main and Jefferson streets in Buffalo, N. Y. The equipment consists of eighty-five ornamental iron columns, each bearing five tungsten lamps, four on bracket arms and one at the apex. The entire cost of the installation has been borne by the merchants on the street, who formed the Genesee Street Carnival Association. The construction work was completed in remarkably short time in order to have it ready for the opening of the carnival on September 5. In fact, it was ready on the preceding Saturday night when the lights were first turned on and elicited much admiration.

APPLICATIONS OF THE ELECTRIC ARC.

BY A. J. MITCHELL.

For fear that the title of this article might create a wrong impression as to the real intent of the author's purpose, it may be well to state in the beginning that it is primarily a résumé of the developments in arc-lamp electrodes, their influence on the future of the arc lamp, and the utilization of these media for illumination, where conditions from the standpoint of physical or electrical consideration justify their adoption as the logical means of providing the light best suited for the requirements. The arc is to be considered only as a source of light and not in its relations to the art of welding or the electric furnace.

As is well known, the first commercially successful arc was produced with a very inferior grade of coke carbon, manufactured principally from the ordinary gas coke mixed with a binder of coal tar. The light, though brilliant, was subject to constant sputtering and hissing on account of the moisture and impurities in the carbon.

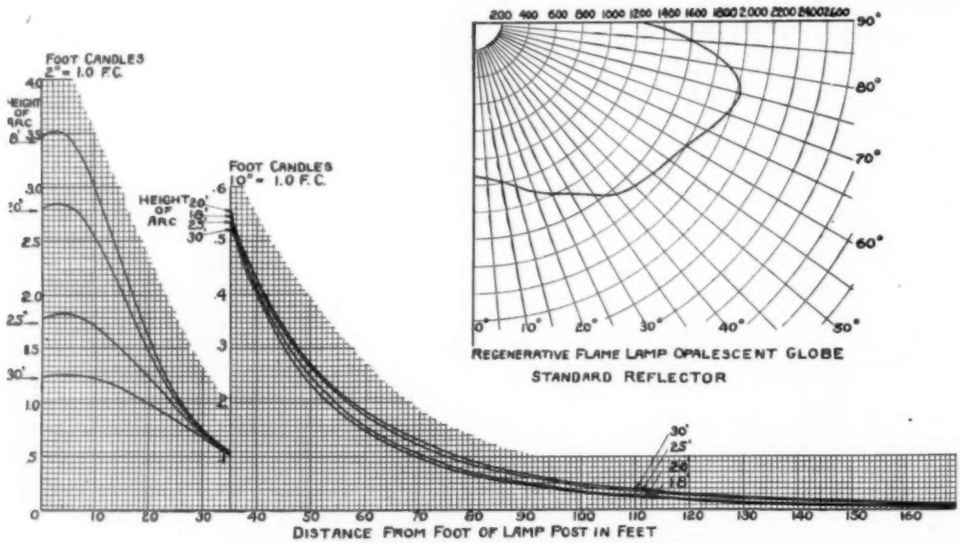
In order to guard against rupturing by strong winds the earlier forms of open lamps, without inclosing globes, were operated at a very low potential, to secure a short arc about 0.19 inch in length, but abnormally high current, usually 9.6 amperes, though sometimes higher. In consequence there was a very rapid consumption of the carbon.

No amount of improvement in the quality of the carbons, which was principally a matter of elimination of impurities, overcame the very serious drawback of short life, and not until the introduction of the inclosed arc lamp in 1894 was this difficulty overcome, and then only by the use of a very much superior grade of carbon, manufactured from lampblack, instead of the gas coke. The inclosing globe permitted of a longer arc, with, of course, higher potential and lower current adjustment. The increased carbon life was responsible for their adoption in many places where the open arc had been barred, on account of high maintenance cost and unsteadiness of the light. Despite these inherent troubles, there were many of the open types installed for interior lighting in lieu of something better, and often under conditions that would make the modern illuminating engineer blush with professional shame to witness the striking disregard of any consideration of distribution, or proportion of candlepower to the space illumed. The writer is familiar with one installation in a city where open arcs are still extant. In a cigar store 10 by 12 feet in area, with a nine-foot ceiling, hangs a 9.6-ampere open arc, the bottom of the lamp being less than seven feet from the floor. On being questioned the proprietor explained that what he wanted was "plenty of light," and he truly gets it "in chunks." There is a shoemaker's shop in the same town, with dimensions about 6 by 9 feet, whose artificial light is supplied by a similar lamp.

The advent of the inclosed arcs and their ready application to both series and multiple circuits was an epoch in the history of the industry and marked the beginning of a series of improvements, both in efficiency and life, that are constantly going on. A proof of this progress and of the substantial results of these innovations is to be found by comparing the few scattered installations in 1894, totalling less than 100,000 lamps, with the present aggregate of more than 1,000,000 in use in this country.

Their adoption for interior lighting was practically coincident with the street installations and the inclosed arc soon became as essential an adjunct to the retail store as to the mill or factory.

The success of the electric arc since its inception as a medium of light has been due to two fundamental facts: first, the ability to transfer energy into heat, by the introduction of a high resistance element in the path of the current, which in this case is simply an air gap; and, second, the highly refractory nature of pure carbon, which permits raising it to a white heat under the influence of excessively high temperature, before vaporization takes place. Sufficient heat generated by any other means than the electric current would be just as effective in candlepower results on the carbon, but by no means so efficient, as far as our thermic knowledge goes at the present time. As it is, only a very small proportion of the wattage consumed in an arc lamp is actually transformed into



CURVES OF ILLUMINATION AND DISTRIBUTION.

effective light, the bulk being dissipated in the long infra-red, and the short ultra-violet rays. We are sensible of their presence only by reason of the heat that accompanies the visible rays. Their chemical action on the salts of silver when subjected to the light is a physical proof of the presence of the short wave lengths. Rapid photography is only possible on account of the chemical violet ray and its instantaneous action on the sensitized filament or plate when exposed to its influence. This mysterious but potent ray has proven valuable as a therapeutic agent in the treatment of many diseases, and the arc lamp, being the most satisfactory medium for securing it, has with the conventional inclosing cabinet become indispensable to many physicians. This same actinic ray, which has made the carbon arc invaluable in photographic work, as a substitute for the sun, has made it equally indispensable for quick work, regardless of weather conditions, both to the photographer and the draftsman. With a 110-volt arc lamp, taking fifteen amperes, a blue print can be taken in about ninety seconds, with the same quality of paper which, in bright sunlight, would require from fifty to sixty seconds, or about two-thirds the time.

Although the proportion of visible radiation produced by the carbon arc is very small, compared to the total energy expended in the lamp, being about two per cent, the efficiency of other light-producing mediums, with the exception of the flame lamp, is very much less, being only 0.02 per cent for the incandescent gas mantle, 0.03 per cent for the Argand burner (oil), 0.43 per cent for the carbon-filament lamp, 1.3 per cent for tungsten and 6 per cent for flaming arcs. In the sources of lower efficiency, the rays are principally in the red end of the spectrum, of longer wave lengths and lacking in luminous intensity. The carbon arc itself is very low in efficiency when compared to an arc formed between electrodes of metallic or saline compounds. It has long been known that titanium produces the most brilliant arc of any known substance, but its high electrical resistance has proven a bar to using it except in combination with some better conducting material, which of course impairs more or less its value as an illuminant.

In their efforts to secure a more efficient medium than pure carbon, and one that was commercially available and easily adaptable to the conventional types of arc lamps, investigators in this field have found that titanium in combination with iron, magnetite and suitable fluxing materials, among the metallic alloys and the calcium compounds, yield the best results.

Suitable lamps for use with electrodes made from these materials are already available commercially, the magnetite or luminous arc for the former and the well known flaming arc for the latter.

The increased luminous efficiency of these materials over pure carbon is due, in the case of the titanium and magnetite, to a preponderance of the blue and violet rays in the spectrum and in the calcium salts to the yellow-green rays. These occupy the center of the spectrum and are the rays of greatest visual sensibility.

Unlike the carbon arc, the light in both the metallic and calcium arcs emanates from the stream of incandescent vapor that flows between the postive and negative tips. The calcium salts, like the titanium, are of very high resistance, but with a lower melting point than the carbon shell or core always used in combination with them, and under the action of the excessive heat generated in the carbon points, rapidly volatilize and form a gaseous conductor of high intrinsic brilliancy.

Unfortunately metallic arcs of the magnetite and titanium class are only suitable for direct current, being a cathode, with the upper or positive electrode consisting of a round bar of copper enclosed in an iron sheath. The tendency of the negative electrode to cool quickly results in a constant rupturing of the arc with each reversal of current, and hence continual flickering when used on alternating circuits. The field of usefulness of this type of lamp has been practically limited to constant-current circuits for street lighting; its adaptation to constant-potental circuits, except at a great sacrifice of wattage in the steadying resistance is as yet a problematical question. It is entirely unfitted for indoor illumination, except for well ventilated buildings of the foundry or rolling-mill class, on account of the noxious fumes emitted.

The distribution from the metallic or luminous arc is almost ideal for street illumination, and is combined with a high efficiency of approximately 0.6 watt for magnetite and 0.36 watt for ferro-titanium electrodes, per lower hemispherical candlepower. The exceeding brilliancy of titanium rays has proven a strong incentive to attempt its use in alternating lamps and some have been tried on series alternating-current circuits, but so far with very doubtful results. An electrode composed of titanium and boron carbides, contained in a shell of pure carbon, has been developed for use in a lamp of the flame type, in combination with an ordinary inclosed upper carbon. This produces an arc of a decidedly greenish-yellow color, of high luminous intensity, about equal in candlepower to the ordinary flaming arc, when operating under most favorable conditions. This lamp would be admirably suited for use on 6.6-ampere series direct-current circuits for street lighting, were it not for the same inherent objection that militates against the more general adoption of flaming arcs on street circuits, namely, short carbon life. The life of the boron-titanium pencil is about twenty hours.

The regenerative type of flaming arc is the only one, so far developed, that meets the requirements of the central stations for general street illumination, the three essential requirements being long carbon life, good light distribution and better efficiency than the older forms of carbon lamps. We might add a fourth requisite for some companies, who demand a white light in preference to the customary yellow ray. The characteristics of the regenerative lamp are long life, high candlepower and excellent distribution, as the accompanying curves show. This lamp has been developed to operate in series, on constant-current circuits, with the ordinary inclosed carbon arcs at 6.6 or 7.5 amperes, and can have either white- or yellow-flame carbons. The efficiency is about thirty per cent less with the white-flame than with the yellow-flame electrodes.

The adoption of the flame lamp for mill and factory lighting, where the height of ceilings will permit, has become so universal that the inclosed carbon lamp is practically being driven from the field. Such a change means a saving to the consumer of at least fifty per cent in current and an enormous increase in the volume of light. Much can be said in favor of the arc as a medium of illumination and its application to the various conditions met

with in the problem of supplying light most advantageously.

Many apparently reasonable and well founded arguments to combat these claims constitute a heavy asset of the advocates of incandescent lighting. In truth, each has its legitimate field, but one is constantly encroaching on the confines of the other, too often the result of what might be termed electrical filibustering on the part of overzealous but impractical salesmen. It is an indisputable fact that the arc has more than kept pace with the incandescent in the contest for higher efficiencies. The tungsten inaugurated a new standard for incandescent ratings and lowered the old equivalent of 3.5 watts for the carbon filament to 1.25 watts per horizontal candlepower.

The flaming arc lamp has extended the value of the watt from 0.8 candles horizontal in the five-ampere inclosed lamp to four candles, or a comparative efficiency of five to one. In considering the installation of lighting units, illumination with consistent distribution and at the lowest cost per candle-foot should be the governing factors. First cost must be balanced against the relative operating cost of different systems; this is a fixed quantity, while the initial cost is a burden that may be entirely lifted in the annual saving of one system over another. Aside possibly from first cost, the arc still represents the highest economy in the transformation of energy into light, and with even a moderate consumption of current on the illuminating circuit, it does not take a great while to note the beneficent effects on the coal pile that the use of lighting units of the maximum efficiency will produce.

Why Unit Costs Increase As a System Expands.

Business men and municipal authorities can seldom understand why the investment and operating costs per telephone increase as a system expands. It is one of the great problems of the industry to convey this principle clearly to men trained in other business, who are inclined to the view that operation on a large scale should mean a reduction in cost per unit.

An interesting explanation of this so-called "telephone paradox" was recently furnished to the public in Seattle, Wash., by E. E. Webster, general manager of the Independent Telephone Company. As reported in *Telephony* he said:

"It is true that the cost increases at a far greater ratio than the increase in business. The explanation is simple enough.

"Suppose that I establish a central exchange with 5,000 telephones, all within a radius of a mile. Say the lines average half a mile in length, and, for the sake of illustration, suppose that the lines cost at the rate of $500 each a mile, or $250 a line. Then you would figure on six per cent interest on your money, or $15, and on the same amount of depreciation, with $20 a year for maintenance and operation. That would make a total of $50 for interest, depreciation, operation and maintenance on each line.

"Now extend your system into the second mile radius, and on that basis the lines would be a mile and a half long and would cost $750 each. Interest at six per cent then would be $45, depreciation $45 and, to be conservative, maintenance and operation $20, a total of $110. To get the average cost for both radii, add the totals, $50 and $110, and divide by two, and you have $80 for maintenance, depreciation and interest for each line. As the plant grows in number of telephones, the expense increases in much greater ratio.

"That's one phase of the situation Here is another. Each position on the switchboard—the section of the board handled by one operator—has 100 answering jacks and, if there is only one position on the board, 100 multiple jacks. When the operator asks you your number, she uses the answering jack, and when she connects you with the number desired, she places the plug in the multiple of the number called for.

"That covers the situation where there is only one position on the board. Now suppose I add another 100 telephones to my system. That means I have to add another position to the switchboard, this position also having 100 answering jacks and 100 multiple jacks. Now I have 200 telephones on the board, so arranged that each operator, when called, immediately can place in the multiple jack the plug connecting the number called for.

"To enable the operator to do this, it is necessary to have the multiple jacks of each position duplicated on the other, so that with two positions I now have 200 multiple jacks on each position. It costs more to install position No. 2 than No. 1, as I not only have to have more multiple jacks on No. 2, but I also have got to get back and install more on No. 1.

"The first position, all installed and ready to give service for 100 telephones, costs approximately $500. To add another position to the switchboard of our company today—a position exactly like the first one and accommodating only 100 additional phones, would cost approximately $3,500. I would have to multiple back through all the other positions, or in other words would have to add 100 multiple jacks to each of the other positions.

"Suppose I put you on a telephone at a fixed charge and I have, say, 500 lines connected with my exchange. I then increase my plant until I can connect you with 18,000 telephones, but although you have a far greater service at your command, I am unable to increase the charge to you.

"In 1905 our company had between 5,000 and 6,000 telephones. Our average number of calls each day for each telephone at that time was five and five-tenths. Today our plant is many times larger and the average number of calls each day for each telephone runs a fraction more than twelve, thus practically doubling the expense incurred in answering each telephone.

"This all shows that no telephone company operating with a fixed rate can increase the number of its telephones beyond a certain point unless the rate is high enough to allow it to make a return on a large and extensive plant. The rate ought to be elastic, but should be controlled by some competent authority so that in no case can it become burdensome and exorbitant."

Municipal Railway Successful in Calgary, Canada.

The street-railway system in Calgary, Canada, which is owned and operated by the municipality, shows highly satisfactory results according to Mayor Jamieson's most recent statement. The gross profits on a capitalization of $476,000 are estimated at $200,000 for the year 1910, reckoned on the basis of the first few months' operation this year.

THE ELECTRIC LIGHTING OF AUTOMOBILES.

BY ROSCOE SCOTT.

One of the most interesting recent applications of the electric lamp is in the lighting of automobiles. There are approximately 350,000 automobiles in use in the United States, and if these were all equipped with electric lamps on a basis of five lamps per car, the total lamp equipment would aggregate 1,750,000. It will thus be seen that the commercial possibilities for the automobile electric lamp are large, and largely undeveloped. In order for the customer to realize the opportunities which are offered by automobile electric lighting, it is necessary to understand the conditions under which the lamps will be used and the precautions which are necessary.

One of the most important conditions which must be realized if an electric headlight is to give satisfaction, is correct focusing of the lamp with respect to its reflector. If it be desired that the headlight beam shall illuminate the roadway to a maximum distance ahead, the lamp filament should be located at the geometric focus of the reflector. Careful tests have shown that a Mazda sixteen-candlepower six-volt lamp with the recently developed "coil" filament, if properly focused in an eight-inch silvered parabolic reflector, throws fully twice as much light on a ten-foot vertical circle fifty feet ahead of the automobile as does a 0.75-cubic-feet-per-hour acetylene burner in an ordinary ten-inch gas headlight. The tests which gave the above results were performed at night in the darkened basement of a large building, a Sharp-Millar illuminometer being used to make the photometric readings. Results of the tests are shown graphically in Fig. 1. In each case two lamps were used with thirty-two inches between centers.

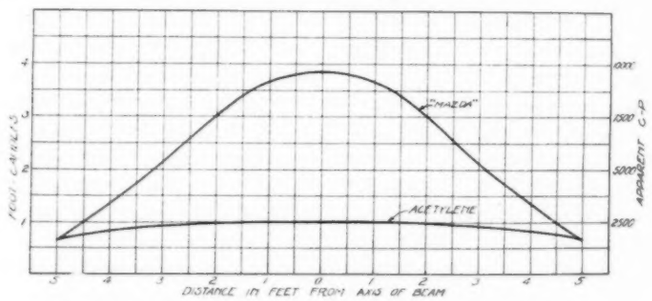


FIG. 1.—COMPARISON OF ILLUMINATION PRODUCED.

The importance of using wire of the proper size cannot be overestimated. Owing to the low voltage (about six volts), the electric lamps on an automobile take a relatively large current and unless wire of ample size is used the voltage drop in the wiring will cause the pressure at the lamps to be reduced and the candlepower will thereby be very seriously diminished. With a knowledge of the necessary constants, it can very easily be figured that a Mazda twenty-candlepower six-volt automobile lamp can be made to give approximately thirteen candlepower, simply by the insertion of twenty-five feet of No. 18 wire in circuit between the battery and the lamp. If, instead, twenty-five feet of No. 10 wire be used, the light intensity would not be noticeably affected, being approximately nineteen candlepower. The general rule may be given that, in order to obtain good results with a complete equipment including head-lights, side-lights and tail-light, the main battery leads should not be smaller than No. 12 B. & S. gauge. No. 12 wire throughout will be found satisfactory, an alternative arrangement being to use No. 10 wire for the main battery leads and for the wires leading to the headlights, and to use No. 14 for the side-lights and tail-light Poor contacts produce much the same effect as too small a wire, weakening the light and making the operation of the lamps uncertain. For this reason the use of an Ediswan attachment plug which will maintain at all times a good contact between detachable parts is excellent practice.

The mention of the Ediswan plug leads to the consideration of the Ediswan candelabra-base automobile lamp (See Fig. 2.). A lamp having this base cannot jar loose in the socket, as it is firmly held in a bayonet joint by means of spring contacts. In the past considerable difficulty has been found with screw-base electric lamps, owing to the fact that no matter how securely they may be inserted, under severe conditions they will work loose. The Ediswan candelabra lamp and socket have eliminated this difficulty in a final and satisfactory manner.

Many machine owners do not care to equip their cars with electric lamps exclusively. Combination fittings have therefore been placed upon the market which permit the use of electricity in conjunction with oil or acetylene, but when such fittings are used the full efficiency of the electric light cannot be realized, on account of structural difficulties affecting the reflectors.

Even if no other electric lamps are used on a car, it is worth while at least to have a trouble lamp with a long cord. Such a lamp may be used with entire safety around and in any part of the machine. It may be provided with a small parabolic reflector so as to throw a powerful beam of light in any direction in which it may be turned. The meter light, reading lamp,

FIG. 2.—MAZDA LAMP.

and the dome light are other examples of the special uses of electric light for motor cars.

While the electric lights may be supplied with current from the storage battery alone, in which case the latter should have an ample capacity and discharge rate, it is very desirable, especially if large lamps be used, to install a generator system of lighting.

Summarizing the main features of the electric system, it may be said without exaggeration that it is safer, more convenient and more economical than any other which has thus far been adopted for the lighting of automobiles. It has no water tanks to leak or freeze, and no flame, which would render the interior of a car hot and stuffy, if used for reading purposes. It employs lights which are not affected by the wind, and which can easily and instantly be turned on or off. Finally, the electric system is susceptible of more varied uses than any other known method.

SOME RECENT TENDENCIES IN STREET LIGHTING.

BY LOUIS BELL.

The last two years have seen a rather encouraging development in street-lighting practice. Municipal bodies move slowly and street-lighting contracts are very commonly made to run for a term of years, which, though generally short, precludes any sudden changes, even when improvements render them desirable. The conspicuous gain has been in a marked tendency to increase the illumination on the streets. Even where the city authorities have not been willing to undertake better lighting the merchants have not infrequently stepped to the front and at their own expense undertaken the proper lighting of important business streets. This is a practical endorsement of the value of good illumination to a community, although it is not altogether creditable that the municipal authorities have left the task to private enterprise.

From the technical standpoint the betterment of street lighting has been very largely due to the introduction of tungsten incandescent lamps and various forms of the flaming arc, including in this category the magnetite arcs, which are now becoming standardized in the higher powers as well as the lower. The four-ampere lamp of this type has been rapidly replacing the inclosed arcs for several years and later the 6.6-ampere lamps have served to displace many of the better class of inclosed arcs which could not be satisfactorily replaced by the smaller magnetites. The flame arcs of other types have not come into as extended use as they deserve, owing to the high cost of the imported carbons used with most of them and the labor involved in trimming. Nevertheless, in a few cities they are decidedly a feature of the illumination, especially in the lighting of open squares.

As a rule, however, the use of improved illuminants, especially these highly efficient arcs, has not been accompanied by the change in methods and locations which their character properly requires. As a very general rule they are placed considerably too low for the best results in practical illumination and in many places those installing them have been neglectful of the very radical change of the character of the luminous source which has been made as compared with the inclosed arcs. These, while indeed brilliant when worked at sufficiently high current, acquire a slight diffusing coating on the inner globes which renders them somewhat less glaring than they otherwise would be. Magnetite or ordinary flame arcs placed at a similar height give as a matter of practice a well-nigh intolerable glare when used with clear globes. Ordinarily the flame arcs are practically never so used and the magnetite, which are of at least as high intrinsic brilliancy, never should be.

All the modern arcs should be placed five or ten feet higher at least than the arc lamps they replace. The lesson of improved distribution from increased height is one that was not entirely lost even in the days of the old open arc, for in some cities, in St. Louis for example, a normal height of twenty-five feet was adopted nearly twenty-five years ago, and this is a good minimum today for first-class street lighting. Foreign practice very commonly placed the lamps even higher, up to ten or twelve meters, with marked advantage in uniformity of distribution. Placed high and with mildly diffusing globes, the modern arcs give an illumination enormously superior to anything attained in the types familiar a few years ago, and care in thus placing and protecting the lights is a thing strongly to be urged on communities which are changing their lighting systems.

The wise course, too, is to take advantage of the increased efficiency of the new lights to increase the illumination so as to give much more brightly lighted streets at the same expense, rather than to attempt to economize by cutting down the number of lights. Arcs in this country are, save in a few instances and those mostly in street lighting done by private enterprise, much too widely spaced. If it is worth while to light a street with any attempt at brilliancy it pays to do the job thoroughly and not to leave it half finished with regions of very low illumination between lamps. The difference between customary practice here and that abroad in this particular is very startling. It would be difficult to state accurately what is the average spacing of arcs in American cities, but it is seldom less than 200 feet even in large cities supposedly well lighted, and more often 300, while in foreign cities of similar size the spacing would never be over 150 feet and commonly little over 100. The same fault of too wide spacing is apparent in the use of incandescent electric lamps, or incandescent gas lamps for that matter, and here again the heights are generally too small for the best advantage. Especially is this the case in the use of Welsbach street lights, which are very commonly installed in the old posts once used for open-flame lamps. Some recent installations, both of tungsten lamps and inverted Welsbachs, have shown a tendency to remedy this difficulty by bringing the lamps up from ten or eleven feet to fourteen or fifteen, to the great advantage of the illumination on the street.

In the use of incandescent street lights there is at present a wholesome tendency to increase the candlepower, a thing which is almost imperative if the lighting is to be improved without very considerable increase in expense due to increasing the number of units. Tungsten lamps of forty, sixty, eighty and one hundred candlepower being now readily available, there is certainly small excuse for the poor and pitiful economy of using smaller units. Even the forty-candlepower lamps are at the spacings commonly employed too small to be used for anything except subsidiary lighting where the lamps serve really as markers of the way rather than as sources of any material amount of illumination. The sixty-candlepower lamp is very widely used, but is so far inferior to the eighty and one-hundred-candlepower sizes that considering the usually small difference in price it seems a pity to waste money upon them.

The most prevalent fault in American street lighting, however, which is now only beginning to be corrected, is the lack of appreciation on the part of many municipal authorities as to what constitutes a suitable balance of lighting in the various parts of the city. In other words, there is a strong tendency to adopt a uniform scale of lighting throughout a city irrespective of the importance of the streets from the standpoint of the illumination necessary to their use. Any attempt at equalizing the amount spent per mile of street over an entire city, large or

small, is bound to result in illumination which is bad from the civic standpoint and generally also bad from the mere illuminative standpoint.

It is obvious to anyone who takes pains to investigate the conditions in a city that certain streets require for various reasons much higher illumination than do others and that it is wise policy from every standpoint to spend money freely in order to secure it. These chief streets from the illuminating standpoint are by no means necessarily streets characterized by large business interest or fine residences. They are determined rather by the amount and character of the night use of the streets. On some principal business streets, for example, dense traffic of every kind practically ceases after nightfall or at least after the ordinary lighting of the shop windows is extinguished and the necessary illumination then is simply that due, so to speak, to police necessities bearing in mind the character of the locality. In other business streets, to the casual observer of much less importance, the sidewalks are filled till late at night, shop lighting is on a much less extensive scale, and good general illumination is imperative. Similar conditions hold for residence streets, some of which for the better preservation of public order or by reason of more general use demand a much higher degree of illumination than do most of the others. These varying conditions are well recognized in Continental illuminating practice, but are greatly neglected here, owing perhaps to a sort of democratic notion that one street deserves to be just as well lighted as another. On the contrary, one street may deserve for reasons having no relation to its apparent dignity very much better illumination than another. There is no rule by which this phase of public lighting may be safely guided. It should be determined by the tact and skill of those in charge of the work. If there be anything in the way of an approximation to a rule it would be that the lighting should be somewhere nearly proportional to the density of the population along the streets, reckoned after nightfall, and this obviously means that most outlying streets, save those that are conspicuous avenues of traffic or that are particularly difficult from the standpoint of the chief of police, need considerably less illumination than most of the others. By working along this line it is possible to secure very efficient lighting without going to abnormally large total expense.

In the city of Hartford, for example, the lighting of which the writer recently reorganized along this line of operations, the average annual cost of lighting per mile of street is almost exactly $500. The average actual candlepower per mile is about 3,250, but it varies from 8,000 or 10,000 to 1,500 or 1,600, the former being on the chief streets fully lighted by arcs and the latter in some outlying districts lighted by incandescents. The result in cost is aided by prices which are very low for an eastern city, but not as low as are obtained in some cities of the Middle West. It is mentioned here merely to show that with modern illuminants, magnetites and series tungsten lamps in this case, it is practicable to do very efficient city lighting without going to expense which ought to worry even a conservative city government.

On the whole the efficiency of the modern illuminants is about double that of those in use five years ago and on the whole the cost per lamp is about the same as it was then, so that practically speaking one ought to find in American cities twice as much light as was then usual. The change to the newer illuminants is of such great public benefit that it should be persistently carried out as soon as conditions of expiring contracts or of changes under existing contracts permit it. Most recent agreements between municipalities and lighting companies contain clauses permitting the use of improved illuminants when they become available, but as a general rule lighting companies are slow to make changes before the expiration of their contracts unless there is considerable economy in so doing, so that improvements are apt to lag.

It is very difficult to say what the course of improvement is likely next to bring us. There does not seem great likelihood of considerable gain in economy in incandescent lamps of the ordinary sizes, either gas or electric. A thing greatly to be desired is a thoroughly good and efficient arc for use on alternating-current circuits, as good, for example as the magnetite has proved to be on direct-current circuits. Improvements are coming along in this line but it is not safe to say that they have yet anywhere nearly arrived. The two interesting European novelities in high-power illuminants "Press-gas" and quartz mercury arcs have not yet gotten a fair foothold in this country. They are both most interesting possibilities the former being used extensively in London and Berlin and the latter having been recently installed in parts of Paris. At present the cost, particularly of mantles and special piping, seems to be against the press-gas, while the manufacture of the quartz arc has not yet been set up in this country, and consequently it can scarcely be referred to as a commercial probability in the near future. But the tendency of street lighting has shown itself to be toward a decidedly higher plane of illumination and in order to secure this it is necessary to have powerful and efficient illuminants, so that any improvement when thoroughly tested will be sure to arrive. The main thing for the present is to make the most skillful use of the light sources now available and the best of these are so good and efficient that there is really no reasonable excuse for failing to adopt them as soon as opportunity offers. Ordinary practice of ten or even five years ago is now fairly out of date and its continuance is a tacit confession to being a back number.

"White Way" Proposed in Hamilton.

The contract department of the Hamilton (Ontario) Electric Light and Power Company is actively pushing the project of creating a "White Way" along the city's principal business streets. It is proposed to install ornamental lamp-posts at the curb line on each side of the street forty-five feet apart. Each of these posts is to carry five 100-watt tungsten lamps, thus producing a brilliant and attractive lighting. Attention is being concentrated on King Street, from Wellington to Bay streets, and on James Street, from Cannon to Hunter streets. A large number of contracts have already been secured from the adjoining property owners and merchants, who are to pay 12.5 cents per month per foot of frontage. The company will install the necessary underground mains, provide and erect the posts and lamps, supply the current and maintain the entire installation in perfect order.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER STATION DESIGN.—II.

SELECTION OF STEAM BOILERS AND DESIGN OF BOILER ROOMS.—I.

BY W. B. GUMP.

The selection of steam boilers has much to do with the operating efficiency of a steam power plant. The steam boiler deals directly with the fuel problem, being the first agency through which the conversion of heat into mechanical work takes place. The factors relating to this conversion will therefore influence the efficiency of the plant as a whole.

In selecting a steam boiler the items of immediate importance are (*a*) kind of fuel to be used; (*b*) steam pressure; (*c*) cost of boiler installation; (*d*) thermal efficiency; (*e*) space occupied.

Fuel.—The kind of fuel to be used is more or less restricted to the particular locality in question. Where it can be had bituminous coal is apt to be selected, as its cost is less than anthracite, although prices of the small lump and powdered anthracite, or semi-anthracite coals are more reasonable and these are used extensively. Due to the slower rate of combustion of anthracite coal the grate area for a given boiler-horsepower must be larger than is required for bituminous or semibituminous coals. A boiler should therefore be built for the kind of fuel adopted.

As the cost of transportation of fuel is a vital issue, a certain kind of fuel will be used almost exclusively in certain sections. In California and the Southwest, crude oil is used entirely for steam power purposes, since the cost of transporting coal renders it prohibitive for the production of power.

Oil fuel possesses a number of distinct advantages over coal. On a basis of calorific value, pound for pound, California crude oil has an average of 18,500 British thermal units as against about 13,000 for good coal. The calorific value is found to be fairly constant throughout a large territory, while this is far from the case with coal. Oil fuel is very convenient to handle in a furnace, and leaves no ash to be removed. One fireman can easily manage from eight to twelve oil-fired boilers. With the same number of coal boilers it is usual and generally necessary to use mechanical stokers.

Oil fuel permits of a higher rate of evaporation than coal, and an oil-fired boiler operates at a higher efficiency under "forcing" than a coal-fired boiler. This was proven conclusively during a series of government tests with liquid fuel.

When employed for fuel, crude oil must be atomized, either by a jet of steam or compressed air. The more common method is by steam. The oil is first heated to a temperature of from 100 to 150 degrees Fahrenheit before it is fed to the burners. It is then forced under pressure into the burner, which includes the steam orifice. Upon striking the steam jet the oil is broken up, or atomized, and burns with intense heat. The amount of steam necessary to atomize the oil should not exceed five per cent of the steam generated, when operating economically.

Due to the high temperature, the brickwork is subject to more rapid deterioration than in a coal-fired boiler. The expansion strains are also more violent. These factors must be carefully taken into account when designing a boiler room for oil fuel, as the question of maintenance is a vital issue. Therefore material of first quality should be specified.

Heating Surface.—The object sought in a boiler installation is to obtain the greatest quantity of heat per dollar. The problem then is how to make the boiler conform to the fuel; not the fuel to the boiler. In this connection it is well to note that manufacturers have employed an arbitrary standard of approximately twelve square feet of heating surface per boiler-horsepower. This is, more or less regardless of steam pressure, nature of fuel, or other important factors, making the rating of comparatively little value as a guide for those receiving bids. Consequently it is necessary to specify the axact heating surface required when purchasing a boiler, basing the heating surface upon the local requirements to be satisfied.

Steam boilers for manufacturing plants operate under comparatively uniform loads. Electric railway service, on the other hand, requires that heavy fluctuations be satisfied, demanding a larger grate area and greater steam space than in the former case. The boilers selected for the railway plant would doubtless operate the manufacturing plant, but the converse would not necessarily be true, as far as economy of fuel is concerned.

H. G. Stott suggests a boiler for electric power service having a ratio of grate surface to heating surface of 1 to 30. When necessary such a boiler could be overloaded 200 per cent. It is a question whether a boiler so constructed would operate economically on light loads, and this would be of great importance in stations having a low load-factor. A ratio 1 to 40 to 1 to 60 is more common than the ratio above suggested. This factor relates to a specific design of boiler best adapted to the working conditions of the case in question, and must be settled accordingly.

Steam-Boiler Losses.—Boiler efficiency, as ordinarily considered, is the combined efficiency of the boiler and furnace. Under extremely favorable conditions this efficiency has reached eighty-three per cent. In practice however, an efficiency of seventy per cent to seventy-five per cent is good, and in a vast number of boiler plants, the efficiency is less than sixty-five per cent of the total heat energy.

In a paper read before the American Institute of Electrical Engineers, Mr. Stott itemized the losses in a steam power station, and made a number of valuable suggestions in the way of reducing these losses. In the boiler room, the greatest of these is the stack loss, or the loss of heat passing off in the chimney gases. In a well operated plant this loss is about twenty-two per cent. In a poorly operated plant it may reach thirty-five or forty per cent. Since the loss is comparatively large in any case a method of reducing it appeals to those seeking high economy.

The chief cause of chimney loss is attributable to chimney draft; that is, a high temperature is required to create the gases which rise and cause an inflow of air necessary to carry on combustion. Thus a large proportion of heat in these gases is a waste. It is therefore clear, from the nature of the case, that a radical reduction of this loss is practically impossible. Undue losses from this source however, are common, and the chief cause arises from incomplete combustion. Too much air is admitted to the combustion chamber, either through leaks, or by improper control of the draft. The latter cause is more common. Not a few plants have poorly constructed chimneys which permit serious air leaks, thus tending to destroy the qualities of boiler equipment, which, in other respects may be first class.

Intelligent firing will go far to improve steam-boiler efficiency, and it may be stated here that this feature of plant operation is too often neglected, notwithstanding the fact that economy in fuel is the main issue. Again, the human element enters into the problem, and it is not generally solved in a satisfactory manner in the average plant using hand-fired boilers. One of the prime causes for unsatisfactory firing, and inefficient boiler operation generally, is accounted for by the fact that few boiler plants are handled by competent or even intelligent firemen. Unfortunately the routine of a boiler room has been regarded as more or less of a drudgery, and, as far as economy is concerned, the question of salaries is too often the chief item considered.

Radiation losses in the average boiler amount to six or eight per cent, and can be diminished only by careful attention to the boiler setting, adopting a type which is tightly inclosed rather than a cheap structure which is not likely to be airtight or contain the necessary amount of heat-resisting material. With regard to a tight setting the internally fired type of boiler offers advantages. In this type the entire furnace is surrounded with steel, and when properly set is favorable to minimum radiation. An all-steel setting has been advocated, and is used in a number of plants with considerable success.

Type of Boiler.—As to a choice between the two general types, fire-tube and water-tube, it is safe to state that more than two-thirds of the boilers installed in electric power stations are of the water-tube variety, and in stations above 2,500 boiler-horsepower capacity fire-tube boilers are not generally to be considered. This is not because the efficiency of one type is necessarily greater than the other; but on account of several other important items, such as: (*a*) Safety to human life; (*b*) accessibility for inspection and cleaning; (*c*) ease with which repairs are made; (*d*) large steam space; (*e*) large capacity per unit.

It can scarcely be disputed that the water-tube boiler is safer under high steam pressure than the fire-tube type. This is because a fire-tube boiler is constructed with all of the tubes in a single shell which is directly in contact with the hottest gases. This affords a greater chance for serious explosions than the water-tube type. A water-tube boiler contains most of the water in separate tubes below the main drums. Explosions are as apt to take place in one or more individual tubes as in the shell, deterioration being confined more particularly to the tubes. The explosion of a single tube is evidently less disasterous than an explosion in the main drum. Furthermore, a fire-tube boiler requires a larger shell for the same capacity and steam pressure; hence a thicker plate is necessary. It is well known that satisfactory riveting is more difficult with thick plates, and the latter do not leave the rolls in as uniform a condition as thinner plates. When it is decided to use steam pressure above 150 pounds a choice of water-tube boilers naturally follows, as a consequence of the facts just given.

As to accessibility for cleaning, the water-tube type is generally superior, as the tubes are more accessible than in the fire-tube boiler. This advantage of the water-tube over the fire-tube boiler is emphasized in plants where the water is of inferior quality. Here, frequent cleaning is necessary, and the demand for facilitating this work is consequently urgent.

In regard to making repairs the water-tube boiler offers a distinct advantage. A tube may be taken out and replaced more readily than in the fire-tube type. The cost of water-tube boilers is greater than fire-tube, and it is generally more difficult to set a water-tube boiler, due to more complicated fittings. As regards efficiency, neither type should show a superiority. More depends upon the character of installation and the manner of operating than upon the type of boiler, and excellent results have been realized from both types. A fire-tube boiler is generally purchased for the sole reason that it is cheaper. Under these circumstances the setting is apt to be slighted, and when complete the efficiency is permanently reduced. This has been one of the causes for believing that the efficiency of a fire-tube boiler is lower than that of a water-tube boiler.

Steam Pressure.—The tendency of present practice is toward high steam pressure. Few new electric plants use a pressure less than 150 pounds gauge, and 175 to 200 pounds is being adopted in practically all stations above 10,000 kilowatts capacity. This calls for first-class piping and fittings in order to decrease the danger to life and property. Apparatus for high steam pressure has been undergoing such marked improvement that casualties in boiler and engine rooms are fewer today in proportion to the amount of power generated than was the case a few years ago when much lower pressures were employed. At the same time greater care is required in handling steam apparatus than ever before, and the method of accomplishing this end must be carefully worked out for each particular case.

Superheating and Superheaters.—Superheated steam is to be considered in all high-pressure steam power plants, and it may be said that practically all the larger plants are now operating with superheated steam, although some engineers still object to its adoption. In America the practice of superheating is comparatively new.

On the continent of Europe superheated steam has been used for many years, and higher superheat is generally used than in American plants. Conditions in this country, both social and commercial, are such as to preclude the adoption of many refinements used in European plants. In the United States the average power plant is pressed into service with scarcely sufficient time for the machinery to be properly installed, not to mention that a portion of the apparatus is likely to be unqualified for economical operation. Competition among builders of power-plant machinery has had a tendency to cheapen their products at a sacrifice in quality, and as a consequence the machinery bought from the lowest bidder is not always suited to refinements of operation that are more or less common in large Continental plants. This does not mean that all power-plant machinery of American manufacture is inferior to European machinery, but rather that a considerable portion of the machinery installed in American plants is not able to compete with machinery of the highest grade, but is installed simply on account of its low price.

The average American power station cannot operate successfully with superheat much above 100 degrees Fahrenheit. This statement applies more particularly to plants with engines of the Corliss type. In most cases the limit recommended is seventy-five degrees. Higher superheats increase the difficulties of proper lubrication of cylinders, tend to warp valves, and cause deterioration at pipe joints and other portions of the plant. A steam-turbine plant is able to use highly superheated steam with less likelihood of trouble than an engine plant. Where the piping and auxiliaries are properly provided for high temperature the steam turbine is able to make a good showing with superheated steam, since the destructive properties of superheat appearing in the engine are practically absent in the turbine.

Superheaters are of two general types; those which are separately fired, and those contained within the boiler setting. More than ninety per cent of the superheaters installed are of the latter type.

The items of importance concerning a superheater are: (*a*) Minimum danger of excessive heating; (*b*) economy; (*c*) accessibility and means of cutting out of service without interfering with operation of plant; (*d*) interchangeability.

On account of exposure to the hottest portion of the furnace, a superheater must be well constructed, so as to satisfy the first item mentioned. This has been a serious problem to meet, but fortunately has been quite successfully solved and at present a well built superheater should not burn out readily if handled with proper care. The type of superheater most commonly employed is constructed of wrought-steel tubes terminating in cast-iron manifolds. In starting up, it is necessary to flood the tubes in order to keep their temperature within a safe limit.

The Foster superheater and one or two other makes do not require flooding, and, while more costly than the ordinary tube type, are longer lived. The type named is constructed of double steel tubes, one within the other, with an air space between, the outer tube being surrounded by a series of adjoining cast-iron rings. On account of the double-tube arrangement a larger area of heating surface is presented for the amount of space occupied than with the other type.

Separately fired superheaters have two distinct advantages: (1) They may be placed in any convenient location; (2) they may be cleaned and repaired without interfering in any way with other portions of the plant. Their chief disadvantages are: extra cost, additional floor space, additional piping, and a greater amount of attention.

A superheater is equivalent to installing additional boiler capacity. The advantages sought are necessarily expected to outweigh the extra cost of fuel and maintenance. This will be the case in well regulated plants, but in plants which are not equipped with good engines and auxiliaries the result from superheating may show a higher cost per kilowatt-hour than without superheaters. There is of course a gain in steam economy per horsepower-hour in any case, but this must be balanced against the actual cost per horsepower-hour, in order to arrive at the commercial economy.

Economizers.—An economizer is in reality a primary boiler, and is used for the purpose of heating the feed water to a greater temperature than that occurring in a steam feed-water heater.

The advantages thus gained by an economizer are: (a) Higher feed-water temperature, and a consequent decrease of wear on boilers; (*b*) the elimination of impurities which would otherwise accumulate in the boilers; (*c*) a large amount of hot-water storage, for sudden increase of load; (*d*) a decrease in the amount of heating surface otherwise required by boilers; (*e*) an annual saving in cost of operation, when other factors are favorable.

The last item is really the most important and determines whether an economizer is a profitable investment.

The disadvantages of an economizer are: (*a*) Extra first cost of boiler equipment; (*b*) extra maintenance (upkeep plus repairs); (*c*) additional space required; (*d*) more complex operation of plant.

The extra cost of the boiler equipment is made up of the cost of the economizer itself together with the cost of additional chimney construction necessary to accommodate the economizer. Since an economizer decreases chimney draft, a taller chimney is required, increasing the cost still further. The items which contribute to a possible saving in the total cost of operation must in every case be thoroughly investigated, if the practicability of such an installation is to be accurately determined.

The first cost of an economizer should range between $4.00 and $7.00 per boiler-horsepower, installed ready to operate.

Chimneys versus Mechanical Draft.—The degree of natural draft in a boiler furnace is determined chiefly by the height of the chimney and the temperature of the flue gasses. After maximum damper-opening has been reached, the draft cannot be increased except by artificial means. It is advantageous under certain conditions, such as in burning fine coal which packs, to increase the intensity of the draft beyond the range offered by a chimney; therefore, a method of producing draft by mechanical means is adopted.

Chimney draft is subject to weather conditions which consequently influence the state of combustion, and hence the economy of the boilers. Notwithstanding this fact the great majority of plants use chimneys in preference to mechanical draft.

Artificial draft may be classified under: (*a*) Vacuum, or induced draft; (*b*) plenum, or forced draft.

In the former system the draft is produced by means of a vacuum above the fire. The draft is thus induced or drawn in, and the effect is similar to natural draft. In the forced-draft system, air pressure is used under the fire, being blown into the ashpit and thereby forced through the grate.

There are two ways of producing artificial draft: (1) by steam jets, (2) by fans, or exhausters.

In the first the steam may be blown through orifices in a pipe in the stack, thus causing induced draft, or may be blown into the ashpit producing a forced draft. The steam-jet system (either induced or forced) is better adapted to boilers which are to be forced for short periods only, since a steam jet is very wasteful and requires a large proportion of steam for the quantity of air admitted.

The usual form of mechanical-draft appliance is a blower in combination with a suitably arranged flue connected to the ashpit, admitting any quantity of air desired. It should be noted that the air pressure created by a fan varies directly as the square of the velocity. The horsepower required to drive the fan increases as the cube of the velocity. Consequently the cost of power for mechanical draft is an important item, and a judicious selection of the fan is imperative in order to secure maximum economy.

When mechanical draft is employed it is not necessary to have tall chimneys. In fact, chimneys are practically eliminated, except in localities in which an ordinance requires high chimneys. It is practice in some plants to use chimneys under ordinary operating conditions, supplementing these with a mechanical-draft equipment for use when forcing is desired. The first cost of a forced-draft outfit will range between twenty and forty per cent of the cost of a brick chimney. An induced-draft equipment requires a much larger fan and is therefore higher in cost than the forced-draft or plenum system. The cost of the induced system varies between forty and sixty per cent that of a brick chimney of the same capacity. The power required for mechanical draft should not exceed five per cent of the total power generated, and may be very much less in a large and economically operated plant.

(To be Continued)

A Simple Service Switch.

A simple automatic service switch devised by R. P. Moody is being used by the Ottawa (Can.) Electric Company on its suburban street-lighting circuit. The city arc-lamp service line is connected in series with the winding of a two-coil electromagnet. The street-lamp circuit is broken just under this magnet, and the ends terminate in mercury cups. Above the cups is a copper connector with ends bent downwards at right angles, so that when the connector is lowered these ends dip into the mercury in the cups and thus complete the street-lamp circuit. The connector, the ends of which are guided to move vertically, is suspended by a cord which passes over a ring and connects to a depending armature, which by its weight normally keeps the ends of the copper connector out of the mercury cups. When the arc-lamp service is turned on, the electromagnet becomes energized and draws up the armature, thus permtting the connector to fall by its own weight, so that its ends enter the mercury cups and complete the street-lamp circuit. Conversely, when the arc-lamp service is turned off, the armature drops under its own weight on to a shelf, draws up the connector, and breaks the street-lamp circuit.

Amsterdam's Municipal Electric Plant.

Consul Frank W. Mahin, of Amsterdam, in a report on the municipal electric plant of that city, states that the receipts in 1909 amounted to $550,098 and the expenditures to $217,458. After paying interest to the amount of $84,408, writing off $159,190, and putting aside a reserve of $2,894, there remained a balance of $86,148. The total amount of electricity delivered for light and power was 16,176,359 kilowatt-hours, of which 8,003,063 went to private parties, 2,010,265 to the municipality (except street cars), and 6,163,031 to the street-car service. For lighting purposes, private parties paid at the rate of five cents per kilowatt-hour and the municipality four and five-tenths cents; for power, private parties paid three cents and the municipality two and seven-tenths cents. For both light and power the street-car service paid two cents.

Coal Briquetting in the United States.

More briquets were made in the United States in 1909 than in any preceding year. Sixteen briquetting plants were in operation, but five of them were only working experimentally and two of these were making briquets from peat. The total product in 1909 was 139,661 short tons, an increase over the output of 1908 of 49,303 tons, or more than fifty-four per cent.

This output is insignificant compared with that of Germany, where 18,000,000 tons of briquets are made every year, but it shows that the briquet industry is at last getting started in the United States. The conditions in Germany, however, are very favorable to the success of the industry.

In the United States the briquet industry is held back by the large supply of cheap natural fuel, by the high cost of labor, and by attempts to exploit secret processes for which extravagant claims are made but which have failed to make good. The material available for briquet making is abundant, consisting of anthracite culm, slack coal unavailable for coking, lignite, coke breeze, and peat; and with the increase in the use of by-product-recovery coke-making processes and the mining out of the more accessible high-grade coals, the briquet industry must surely find a larger market and make a greater output.

The Geological Survey has just published a report on coal briquetting in the United States in 1909, by Edward W. Parker, which may be obtained by applying to the Director of the Survey at Washington.

Cheap Power for Kansas City.

A recent report from Kansas City, Mo., states that the Niangua Hydro-Electrical Company, capitalized at $150,000, owning the land on each side of the Niangua River, plans to generate 30,000 horsepower at one cent per kilowatt-hour, $60 per horsepower per year, which would make an income of $1,800,000 gross. It will cost about $2,500,000 to construct the dam and install the machinery, including the transmission line to Kansas City. It is the object of the company to capitalize for $5,000,000, issue $2,500,000 worth of bonds, ten years at six per cent, and lay aside a sinking fund of $500,000 annually to redeem the bonds. The company has the decree from court, and is all ready now to go ahead.

TELEPHONY—TELEGRAPHY, and WIRELESS.

EFFECT OF DAMPING FACTOR UPON THE SENSIBILITY OF DETECTORS IN WIRELESS TELEGRAPHY.

BY H. H. GORDON.

It is a fact well known among those interested in wireless telegraphy and telephony, that all forms of detectors are not equally sensitive under a given set of conditions. Among the factors affecting the sensibility of a detector might be mentioned the wave form, the wave train, the group frequency, the damping factor and the coupling of the circuits.

At present the design of wireless receiving circuits, taking into account the factors mentioned above, is more or less of an experimental matter, different connections and different forms of apparatus being used and various adjustments tried and experimented with until a satisfactory operating condition is reached.

It is thought that if the same engineering principles were applied to the design of the receiving circuit that are applied to the design of a dynamo or motor, that much improvement over the present empirical methods would be made, and it was with a view towards the same that the following tests were made at the experimental wireless station of George Washington University, with the efficient assistance of J. R. Whitehead and L. S. Paddock.

The oscillatory current used in wireless telegraphy may be defined as an alternating current of extremely high frequency, the maximum values of successive waves continually diminishing. The ratio of one maximum value to the next is called the damping factor. If this ratio is large, the oscillation dies away quickly and the oscillation is said to be strongly damped, or to have a large damping factor. If the ratio is small, the wave or oscillation does not die away quickly and the oscillation is said to have a low damping factor. A pure alternating current would, of course, have no damping factor.

The effect of oscillatory currents of different damping factors was tried upon the following detectors, which it was thought represented the best known and most widely used types: 1, electrolytic; 2, perikon; 3, silicon; 4, carborundum.

The electrolytic detector is composed of a very fine platinum point just touching the surface of an electrolytic solution in a small glass or platinum cup. The perikon, silicon and carborundum detectors are all of the crystal type, which in general is composed of two elements in contact under slight pressure.

The equipment of the experimental station comprised an L-type aerial of four phosphor-bronze wires, horizontal length 100 feet, vertical length fifty feet. The outer end of the aerial was ninety feet above the street. The transmitting set was of one-kilowatt capacity, using alternating current at 110 volts and sixty cycles in a 30,000-volt, open-core-type transformer. Fessenden connections were used on the oscillation transformer, which was of the direct-couple type. The receiving circuit was so designed as to allow of a number of different arrangements. The receiving tuning coil was of special design and could be used for both direct and inductive coupling. The adjustable condensers were of the usual semi-circular plate type. The complete wiring diagram of the station is shown in Fig. 1.

It was first planned to make use of a station about three quarters of a mile distant to transmit the signals for the tests, but on account of interference from the near-by stations, this scheme had to be abandoned and a small transmitting set, comprising a storage battery, mechanical interrupter, coil, oscillator, transformer and condenser, was installed in the same building with Station 1. The set was connected as shown in Fig. 2. This arrangement of circuits gave very weak radiation, but it was powerful enough for the purpose. It also had the effect of giving the system but one oscillation constant to deal with, instead of the two which are usually present in the ordinary form of coupled circuits.

In order to note the effect of the damping factor it was necessary to find means whereby the mean-square value of the received current could be measured so as to maintain this value con-

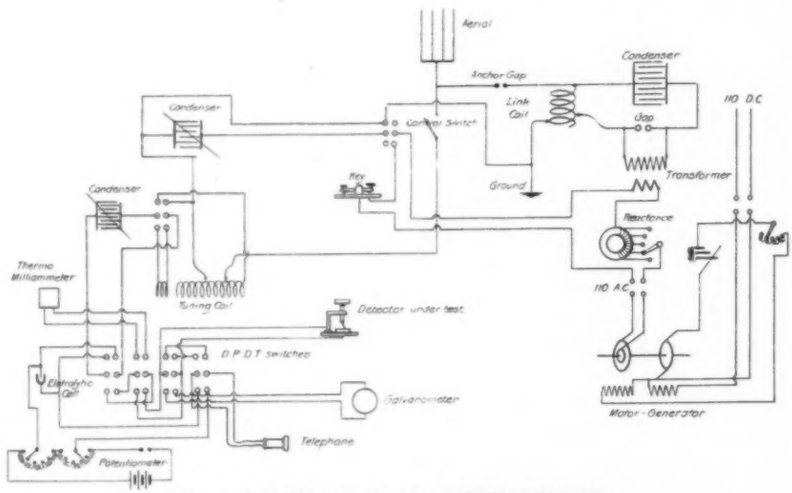


FIG. 1.—WIRING DIAGRAM OF TEST STATION.

stant, and note the effect of changing the damping. Some difficulty was experienced in the selection of an instrument for this purpose. A thermo-milliammeter was finally selected, as it was found to be remarkably sensitive and well adapted for the purpose. This instrument consists of a moving-coil element carrying the pointer and also carrying a delicate thermo-couple on its mounting. Directly under the thermo-couple is a narrow strip of gold leaf through which the current to be measured passes.

There were no instruments to be obtained for measuring the damping factors of the wave trains, so the following method was evolved.

Three different combinations of capacity and inductance were arranged as follows in the transmitting set.

The capacity in the set was composed of Telefunken tubes. The set was tuned up to a wave length of 550 meters. Call this $W_1=\sqrt{C_1L_1}$ where C is the capacity and L the inductance. The capacity was then lessened by two tubes

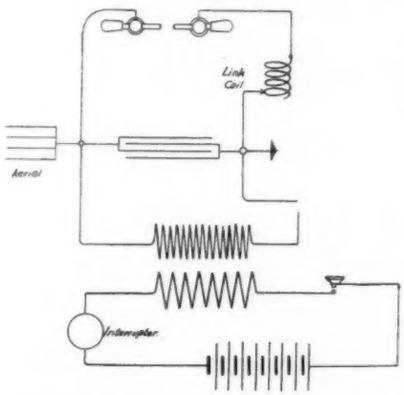


FIG. 2.—CONNECTIONS OF SENDING STATION.

and the set again tuned to 550 meters. Call this $W_1=\sqrt{C_2L_2}$. Two more tubes were then removed and the set tuned to 550 meters. Call this $W_1=\sqrt{C_3L_3}$. The full capacity was again inserted and the value of $\sqrt{C_1L_2}$ and $\sqrt{C_1L_3}$ were very carefully measured with the wave meter.

The results were as follows:

$W_1=\sqrt{C_1L_1}=\sqrt{C_2L_2}=\sqrt{C_3L_3}=550.$

$W_2=\sqrt{C_1L_2}=635.$

$W_3=\sqrt{C_1L_3}=780.$

The damping factor D of any circuit equals $\frac{R}{2L}$ in which R is the high-frequency resistance of the circuit. Call the three damping factors of the three different combinations: D_1, D_2 and D_3.

Then

$$D_1 = \frac{R}{2L_1}$$

$$D_2 = \frac{R}{2L_2}$$

$$D_3 = \frac{R}{2L_3}$$

R can be assumed to be unchanged in the three cases, above, as the tuning coil was made of very heavy wire and the change in the total length of wire was slight.

Therefore these two proportions may be made:

$$\frac{D_1}{D_2} = \frac{\frac{R}{2L_1}}{\frac{R}{2L_2}} \text{ or } \frac{D_1}{D_2} = \frac{L_2}{L_1}$$

also $$\frac{D_1}{D_3} = \frac{L_3}{L_1}$$

The following proportions are also true:

$$\frac{W_1}{W_2} = \frac{\sqrt{C_1L_1}}{\sqrt{C_1L_2}} \text{ or } \left(\frac{W_1}{W_2}\right)^2 = \frac{L_1}{L_2}$$

similarly $$\left(\frac{W_1}{W_3}\right)^2 = \frac{L_1}{L_3}$$

therefore $$\frac{D_1}{D_2} = \left(\frac{W_2}{W_1}\right)^2$$

and $$\frac{D_1}{D_3} = \left(\frac{W_3}{W_1}\right)^2$$

also $$\frac{D_2}{D_3} = \left(\frac{W_3}{W_2}\right)^2$$

The above gives us a ratio between the damping factors of the three arrangements of the circuit in terms of wave length.

The method of using the above in testing the detectors was as follows.

The receiving set was tuned very carefully to the 550-meter wave length, and the combination $\sqrt{C_1L_1}$ set on the transmitter, the points L_1, L_2 and L_3 being marked on the link coil. The Duddell thermo-milliammeter was then connected in the receiving set and the transmitting key of Station 2 held down long enough to obtain a reading on the thermo-ammeter. A system of signals was arranged between the two stations and a word was then sent to the transmitter whether the reading was high or low. The output of the transmitter was then regulated by means of the vibrator of the coil until a predetermined deflection was obtained on the thermo-ammeter. After this was adjusted by the vibrator, an additional finer adjustment was sometimes made by means of the adjustable air condenser of the receiver. This would throw the closed circuit more or less out of tune with the open circuit, but would not affect the damping factor as the inductance was not varied. In this manner the high-frequency current in the receiving circuit was always reduced to the same value before a detector test. After the above had been done the thermo-ammeter was switched out and the detector under test was switched in together with a D'Arsonval galvanometer and shunt. The average of fifteen readings was taken and these readings were only the best, the detector being adjusted each time with practically the same care

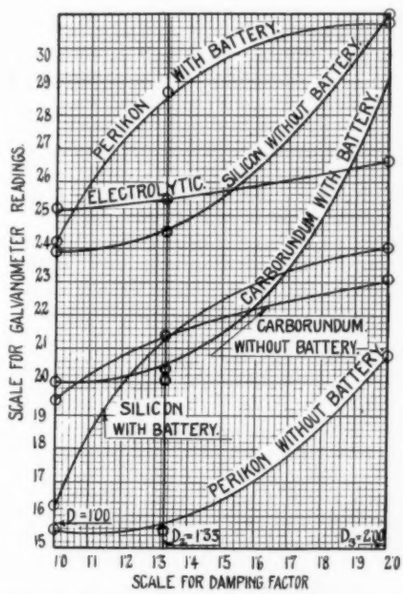


FIG. 3.—VARIATION OF DETECTOR SENSIBILITY WITH DAMPING FACTOR.

that it would have under actual service conditions. This in reality often meant fully three to four times as many adjustments as readings.

After this had been done for the value $\sqrt{C_1L_1}$, the same was repeated for the values $\sqrt{C_2L_2}$ and $\sqrt{C_3L_3}$, care being taken to bring the high-frequency current back to the standard each time, and checking the standard again after each set of readings was taken. If this reading did not check with the first the set of readings was repeated.

In the case of the glass point electrolytic detector but one set of readings was of course necessary, for the conditions of the detector were always those of the same sensibility.

The shunt used with the galvanometer was of the same value throughout the detector tests without the battery. In the tests of the detectors with the battery it was altered somewhat, and on this account the curves taken with the detector cannot be taken as having values which can be compared with each other at all in regard to sensibility, because the flow of battery current was divided between the detector, galvanometer and shunt, and the resistance of the detectors was unknown, and would have had to be determined for each reading.

Assuming that the damping factor D_1 is unity, the values of D_2 and D_3 were found to be 1.33 and 2 respectively. The actual values of D_1, D_2 and D_3 were not obtained, as they were not necessary for the experiment.

The following are the average readings of the galvanometer for each damping factor:

Detectors.	Readings with D_1	D_2	D_3
Silicon, without battery	23.9	24.4	31.0
Perikon, without battery	15.8	15.5	20.8
Carborundum, without battery	19.6	21.4	23.1
Silicon, with battery	16.4	21.6	24.1
Perikon, with battery	24.1	28.8	30.7
Carborundum, with battery	20.0	20.0	28.4
Electrolytic, with battery	25.0	25.5	26.5

This variation in sensibility is also shown graphically in Fig. 3. From these results it would appear in general that the detectors became more sensitive with increased damping. But it must be remembered that the above showing is under constant value of the mean-square-root value of the receiver current, and in maintaining the same value for the heavy damped as for the slightly damped wave, the former will have the higher initial amplitude.

While these results are in themselves too crude and inaccurate to draw any conclusive results as to the theory of the action of wireless detectors, they certainly do not substantiate the theory of thermo-electric action in the case of the crystal detectors, but tend rather to uphold the theory that there is a certain critical potential which exists in the detector and which is broken down by the initial swing of the wave.

Coherer Action.

M. Azilard, who is connected with Mme. Curie's laboratory at the Paris University, has observed some new and very striking phenomena in regard to coherer action. He gives the following account of his researches in a paper presented to the Academy of Sciences. A coherer is mounted on a well insulated support and connected as usual to a battery and relay. The coherer has at one end an antenna of one meter length. He does not connect the coherer to ground as usual, but puts it in contact with one pole of an alternating-current circuit, the other end of which is grounded. In this way he greatly increases the working distance of the coherer. Using a second antenna for the emission and a small spark, the maximum range of action is but two millimeters when one puts the coherer to ground as usual, but it is increased to 1,200 millimeters with the above connection. Replacing by the ground connection, the distance falls to the initial value. The length of the emitting antenna is one meter and it is excited by a 1.0 to 1.5-millimeter spark produced by rubbing an amber rod. The alternating current comes from the city mains at 110 volts and forty cycles, or is given by a small rotating commutator device at variable frequencies. He showed that the increase in sensitiveness of the coherer was not due to a change in capacity or self-induction of the coherer circuit, nor to the simple metallic connection with the lighting mains.

He uses this arrangement to bring out another phenomenon which is as follows: There is produced an action between the emitting and receiving system when one makes contact between an insulated metal piece and another piece of metal. The emitting rod is held in an ebonite support and is touched with a metal piece held in the hand. Such action takes place at 5 to 150 centimeters from the receiving end and produces an effect on the coherer. The contact must be suitably made, however, and when it is suddenly produced and with large surfaces of metal we have no result. A contact with a very small surface is required here, and when such contact is very light and gradually applied, there is an effect on the coherer at a distance. A fine metal wire is soldered to the sending rod and it is touched with a steel file held in the hand. A microphone contact is found to be the best for producing the effect. The distance at which the action takes place varies for different metals. A contact between iron and iron is better than one between brass and brass, or aluminum with the same metal. Non-metallic conductors, such as salts of different kinds or liquids, will not produce the effect, nor is it obtained with dielectrics. Metal plates interposed between the two antennae will cut off all the waves. Glass of the same thickness has less action. He could also produce the waves by an inductive effect. The grounded rod is placed in a tube of small diameter surrounded by a layer of fine insulated wire, and one of the bare ends of the wire is touched by a piece of metal. The effect is produced in this case, but the coil alone without the antenna will not produce it, nor is it obtained by grounding one end of the coil and touching the antenna, although the coil is insulated from the latter. Instead of the coil one can use an ebonite tube surrounded by a metal tube.

The action is not due to the simple electrical effect of metallic contacts or to thermoelectricity, nor to a charge from the air, nor to alternating current impulses transmitted to the sending antenna by the person's body or any other substance. Other conditions being equal, the maximum working distance is greater when the two antennae have the same length. One can find by trial the best relation between the capacity and self-induction of the two systems. The capacity of the metal body, etc., making the contact should be large in proportion to that of the sending antenna, and it is best to make the contact at the upper end of the latter. In all cases, the coherer is to be connected to an alternating-current circuit as stated above.

Wireless Communication With Besieged Cities.

An extensive trial of wireless telegraphy is being made in connection with the present army maneuvers in Germany. A number of important cities are supposed to be besieged and efforts are being made to establish wireless communication with them. Portable wireless stations are being used and a study made of the best means of sending wireless messages without interference from the attacking army. Details of methods and results are being carefully withheld, however.

Prince Rupert, the western terminus of the Grand Trunk Pacific Railroad and a township of but three years of age, has decided by an overwhelming vote to buy the local telephone system, enlarge and modernize it, and operate it as a municipal proposition.

ELECTRICAL Advertising *and* Selling

THE FUTURE OF CENTRAL-STATION ADVERTISING.[1]

BY CHARLES A. PARKER.

Until about ten years ago the question of supplying a community with electric current for the comparatively few uses to which it was then being put was regarded almost entirely as an engineering problem. At that time men who were engineers pure and simple swayed the destinies of the various central stations throughout the land and were almost a unit in their blindness to the magnificent commercial possibilities of the commodity in which they were dealing. Indeed by far the larger number would have repudiated the very idea of electricity being a "commodity."

How, forsooth, could electric current which had to be created as it was used be compared with shoes or bread or neckties which could be made and then stored away until somebody walked into the store and asked for them?

"Why," they urged. "if electric current is pushed as merchants push their lines, the central station will soon find itself swamped. It will be compelled to make an investment which will lie idle most of the time only to be overworked when the demand comes."

This was the early viewpoint and, of course, there was no small amount of truth in it, seeing that it was impossible at that time to predict the development of a large day load and the invention of high-efficiency lamps to help level the peak.

This was the spirit which the original advocates of the application of commercial methods to electrical development had to contend. They were up against the proposition of making a technical man realize that the central station's real problem was one of selling and to be solved by the same means that the merchant solved his own—namely by the application of the forces of salesmanship and advertising. The triumphant manner in which the pioneer "commercial" electrical men were vindicated is too old a story to need repeating here. The fears of the engineering heads of central-stationdom failed entirely of realization while the golden stream that advertising had started flowing into the central station's coffers was ever increasing in volume.

This was the first result of central-station advertising, the nature of its problem having been threefold. It not only had to prove its own applicability to the case, but it had to educate the public to the value of electricity for the home, the store, and the factory and was also compelled to vindicate the right of the central station to its very existence.

Only a detailed comparison of the way people lived and did things twenty years ago with the way people live and do things today would show the remarkable revolution that electricity has wrought. No phase of human existence has been untouched by its magic and much of the credit for the miracle must be given to advertising.

While electrical geniuses have been busy harnessing the lighting to the needs of mankind, advertising has been educating mankind to a realization of those needs and to the higher standards of living that electricity has made possible.

As a part of this task it has been compelled to act as mediator between the central station and the public.

It has been compelled to down the spirit of suspicion and hostility with which people were formerly, and in some cases still are, accustomed to regard any public service corporation.

It has explained and made clear, at least to intelligent people, the necessity of the central station making its charges on the basis that it does and has been able to create a spirit of cordiality between company and public, developing in the latter a realization of the community of interest that exists between the two.

All along the line, advertising has acted as first aid to the central station in the increasing complexity of its work. It has been the medium through which new conditions and new uses of electricity have all found adjustment to the central station's profit.

Few will deny the efficacy of advertising in meeting these first problems of the central station and there should be no reason from these standpoints why the central station should not be on a very satisfactory basis and ready to tackle the problems of the immediate and remote future as they arise.

If any particular central station is not so situated, it is dragging along behind the times and should make strenuous efforts to catch up with the procession because there is work to be done—work that will only be complicated and rendered difficult of profitable settlement by old matters bobbing up and demanding attention.

The present is a period of change. New conditions are arising which demand attention and practically all of them should be a source of self-congratulation to the central station rather than matters of concern. By the judicious application of the forces of advertising, these new developments can all be turned to the profit of the central station.

Of course, there is nothing particularly novel about the introduction of new electrical devices. This movement has been characteristic of electricity ever since man interested himself seriously in the mysterious element.

High-efficiency lamps, electric vehicles, electric ventilators, electric vacuum and suction cleaning devices have been mentioned and treated of in previous articles and are enumerated here merely for the sake of completeness. Central-station advertising of the immediate future should have these things as its subject matter and that central station will find these things most profitable which is in a position to give them the most attention.

NATIONAL ADVERTISING.

We really begin to touch on the spirit of the times when we come to

[1] The eleventh of the present series of articles on "Central-Station Advertising," appearing in the second issue of each month.

consider the disposition of manufacturers of electrical devices to advertise both directly and indirectly to the user.

This, of course, is quite in keeping with the present tendency of large manufacturers in every line to become national advertisers. Just as makers of saws, roofing, and what-not are finding their way into the pages of the popular national magazines, so are the manufacturers of fans and flatirons doing the same thing.

They are going after the public directly. They intend to make the public realize, if possible, that their particular make of fan or iron is the type it wants and that it should surely want some type.

What is more significant—they are not resting content with this magazine advertising, they are going to the public directly—via Uncle Sam and the one-cent stamp.

This being the case—what should the central station do about it? A superficial view of the matter might suggest, inasmuch as the manufacturer shows a disposition to do the work, that the central station should let him do it, the latter reaping its reward in the shape of increased current consumption. Such an attitude is, however, extremely short-sighted.

The wise central-station advertiser will take his cue from the maker and will secure for his company the maximum benefit to be derived from the manufacturer's use of the national mediums.

Advertise to your public, calling attention to the advertising the manufacturer is doing in the magazines as well as to your ability to supply the prospect with the goods being exploited. This will not only serve to increase the effectiveness of the magazine but will tend to draw any business there is to you.

Here also, as is the case of high-efficiency lamps, the aim should not only be one of securing profits but of keeping control of the electrical situation in your particular field as much as possible.

And remember this. It isn't manufacturers of fans and irons alone who are advertising. Practically every type of electrical device is included—ventilators, lamps, suction cleaners, washing machines, etc., and it is safe to say that there is not one advertiser who would not welcome the co-operation of the central station.

Remember this also. Co-operation does not necessarily mean that the central station should advertise the same lines of goods. It does mean that the central station emphasizes this advertising by calling attention to it repeatedly and by urging the prospect to take action via the central station.

ELECTRICAL SIGNS FOR NATIONAL ADVERTISING.

A few years ago progressive electric-sign men began to wonder whether or not large national advertisers could not be induced to make use of electrically illuminated signs throughout the various cities of the country. Wondering led to planning. Planning led to action with the result that large national advertisers are beginning to show a very active interest in the matter of electric signs.

Now, of course, no advertiser is as skittish or exacting as the experienced national advertiser who spends hundreds of thousands of dollars a year and who knows exactly what his advertising ought to bring in as well as how to make it bring this in. Such an advertiser isn't going to scatter expensive electric signs throughout the country indiscriminately. If you want your share, you'll have to go after it and go after it hard.

First of all, pick out the best locations in your town for large electric signs and secure control of them if possible. Gather statistics regarding the number of people who pass these places at various times of the day and night. Note the types that seem to predominate. This will give you a line on the particular kind of national advertiser to whom any particular location should be attractive.

Communicate with such party or parties urging on them the value of a sign to them in the location you have in mind and impressing on them your willingness to co-operate with them in every way possible. In fact, it will be found valuable to have a definite proposition framed up in some way that will invite immediate action.

Steps should also be taken to interest the various sign companies in attractive locations in your city. It often happens that they hold the key to the selection of locations for signs by national advertisers. By working in conjunction with them and aiding them by calling their attention to good places for signs, a central station is practically certain to get very serious and very profitable consideration from national advertisers.

This is a new field that is just being opened up and which will call for a considerable amount of advertising attention from central station in the future.

MODERN CONSTRUCTION AND MUNICIPAL STREET LIGHTING.

Not less important than the matter we have been discussing is the question of the central station's attitude in the future to the municipality of which it is a part.

Already the most progressive companies are pointing out the right path to follow by adopting a very liberal attitude toward their critics and recognizing a very broad idea of civic duty.

There is no doubt but that electricity is to a very large extent the solution of the question of health and beauty to the average community. If a town enjoys the greatest possible benefits of electricity, it can hardly help being clean, light, healthful, and beautiful.

It generally falls to the central station to lead the way to the city healthful and beautiful—The Electric City. It has its choice between a generous civic programme or a narrow, selfish policy which has only immediate profits in mind and which condemns the city to a continuation of conditions which, while tolerable or even desirable when there was nothing better to be had, become intolerable in the light of modern electrical progress. We refer here chiefly to the question of modern municipal street lighting and the installing of central-station mains by means of underground conduits.

This is not the easiest matter either to talk about or to settle. Central stations that have thousands of dollars invested in overhead construction cannot be expected to view with anything but alarm the idea of supplanting this system by an underground one.

Nevertheless it is safe to assert that within the next two decades there will be few central stations that will not be called upon to do this very thing. With this fact in mind, isn't it the part of wisdom to make plans for the change and to prepare to make a profit out of it rather than be compelled to stand a loss?

That is exactly the difference that there will be between the adoption of a progressive policy followed up by a vigorous advertising campaign and the deliberate closing of one's eyes to the

inevitable. Overhead construction with its municipality of wires and its ugly poles is bound in the long run to give way to underground conduits that are safer and better in every way. If a central station begins today to recognize this fact and to change its system as rapidly as it can to an underground one, it is paving the way to a pleasant and prosperous relationship with its patrons in the future.

Now the question will naturally be asked, what has advertising to do with this?

To put the matter briefly, it has everything in the world to do with it.

Hiding one's light under a bushel is a very poor thing to do in the business world. If the central station deliberately plans to change its system for the benefit of the municipality and its people, in justice to itself it ought to keep the public well informed of its plans and its progress. An advertising campaign with this as its object will be found to more than pay for itself both in increased business and in the entrenchment of the central station in the public favor.

A matter more pleasant to consider than the uprooting of the present overhead system is the question of modern municipal street lighting.

High-efficiency lamps plus newly invented globes and reflectors have made a form of street lighting possible today that would not have been dreamed of years ago. This in its best form involves the installation every hundred feet or so of clusters of globes equipped with modern electric lamps. The effect of such a system is extremely beautiful and inasmuch as this street-lighting system demands that the wires are laid in underground conduits, it offers the central station desiring to change its system a good chance to get in an entering wedge.

A large number of central stations are agitating this question at present and more will find it a profitable field of effort. The objects of attack should be the merchants along the principal streets as well as the city fathers. The slogan should be "all together for the City Beautiful."

Some sort of an arrangement might be made by which the city stands part of the expense while the merchants on the streets benefited bear the remainder of the cost.

It is a matter that every live central station will find well worthy of its attention—not at some time in the dim distant future, but now.

With the inspiration of a large number of other cities which are working along the very lines we are suggesting here, it should not be very difficult for the central-station advertiser to arouse the civic pride of the merchants to a point where they will be anxious to have their city make the very best possible showing.

FIGHT FOR PERFECT INSTALLATIONS.

Another matter which the central station should begin to advocate in its advertising is the installation in buildings of the very best and most modern forms of electrical construction.

As electricity progresses toward greater perfection, there will always be a large number of electrical contractors who will find it easier to stick to old and inferior methods than to adjust themselves to new improved forms.

Contractors of this character have made their presence felt in faulty, obsolete installations that have given their patrons trouble and have been the source of much of the dissatisfaction which the central station has been called upon to bear.

The wise central-station advertiser will in the future make clear to architects, builders, and prospective house and building owners the value of nothing but the very best in things electrical.

By so doing, he will not only help to establish the company more firmly than ever in the good graces of its patrons but he will also be avoiding much future trouble and be doing his share toward eliminating the cheap electrical contractors who get business on the basis of low prices and whose work is at once a menace to the people for whom it is done and to the central station as well.

These then are some of the most pressing problems which the central-station advertiser will be called upon to meet in the near future and which can be solved by the adoption of the right policy and the pursuance of a wise advertising campaign built upon that policy. From now on the central-station advertiser who desires to do his full duty will be called upon to secure for his company everything that can be secured through the national advertising that is being done by manufacturers of things electrical; he must see to it that it gets its full share of attention from national advertisers who are coming to see the value of electric signs; he must so work that the substitution of underground systems for overhead construction, which is inevitable, will be made as easy and a source of as little expense and loss to the central station as possible; he must see to it that the street-lighting system of his city does not fall behind in the march of progress; and finally that people who build or remodel be fully acquainted with what the best forms of construction and installation are and that they be shown the folly and danger of inferior work.

Of the remote future of central-station advertising, no man is seer enough to give the details. This much, however, is certain. In spite of all that has already been accomplished and is being accomplished, electricity is still in its infancy. The future has possibilities probably beyond even the most gifted imaginations. The extent to which the use of electricity for lighting has been developed but indicates the possibilities that lie before it in its other phases. With these facts in mind, every central station should make its plans for the future on the broadest possible basis, for only such will reap the richest rewards and make the most of electricity—the "greatest agent of progress."

Newspaper Advertising.

Louis Wiley, business manager of the New York *Times*, in a recent address before the convention, at Omaha, of the Associated Advertising Clubs, expressed the following sound and pertinent arguments in favor of proper newspaper advertising:

The newspaper advertisement has become an important factor in our civilization. It is recognized by the government as an effective way to communicate intelligence to the people, and indeed it is one of the most popular mediums of communication between the citizens.

The growth of newspaper advertising has brought about a change in methods. The formal cards of merchants which were once regarded as the most effective advertisements have given way to carefully prepared advertising news, announcements of which the great department stores give the best examples. So important has the business of advertising become that many of the dry-goods stores employ staffs of writers who give as much thought and time to their work as do the news reporters and editors—frequently more.

The newspaper is the best medium for advertising, for the subject matter of all advertising is news—news of commercial and industrial progress, news of artistic development, news of the latest fashions, in dress, food, jewelry, and the arts. The

newspaper creates a healthy competition among merchants besides enabling them to give possible patrons details of what they have to sell. The small trader has the same opportunity as the big merchant. He begins in a humble way, it is true, but he is not overwhelmed by his wealthy competitor.

The most difficult thing for a news editor is to separate the news from advertising. There is so much news in advertising, and frequently so much advertising in news, that great skill and judgment are required to make a successful separation. The constant effort on the part of the advertiser is to use the news columns for his advertising purposes. Many are the ingenious efforts of advertisers to secure free publicity. I think the best rule for an editor to observe is to treat news as news. If a thing has news value, it should be printed whether or not it helps the advertiser, but it should never be printed as news simply because it helps the advertiser and is not really of news interest. The tendency of the editor is to shrink from the publication of news matter if he thinks an advertiser is interested in it. That is the wrong point of view. The mere fact that an advertiser has some connection with the news should not hinder its publication. The only point the editor should consider it, "Is it of interest to the reader?"

It is frequently charged that newspaper editors are influenced in the conduct of their publications by the business office or by advertising considerations.

There is very little basis for this critimism. On the whole, the newspapers of the country are self-respecting and do not attempt to deceive their readers. In an address last year Don C. Seitz, business manager of the New York World, said:

"There is a certain spirit that vibrates through all newspaper offices of any account; the feeling that the paper must stand well; that it must be free; that it has a certain public duty to perform; that, after all, it is the voice of the people; that people look to it for their daily information; that they must get this news as accurately as one or two pairs of eyes can see it for many pairs of eyes, and that nothing must be printed that is knowingly wrong or maliciously biased."

The modern newspaper serves many useful purposes, but none more useful than that of bringing the buyer and seller together.

The sincerity of the newspaper which proclaims its devotion to the public welfare in its editorial columns and sells its advertising columns to quacks and frauds is open to question. That newspaper has the greatest value as an advertising medium which declines fraudulent advertisements.

Many newspapers help advertisers to perpetrate frauds on their readers. They print advertising matter so that it will simulate news, and they thus betray the confidence of their readers. A falling and not a rising circulation generally characterizes this indefensible course. A newspaper to deserve respect should be something more than a vehicle for the schemes of tricksters and sharpers. No self-respecting newspaper will knowingly accept an fraudulent advertisement.

The day is approaching when the newspaper will be employed by certain professions which now pay regard to what is known as etiquette, or ethics, which results in a distaste for advertising. It is this feeling which is working much mischief in the prosperity of young physicians, budding lawyers and engineers. Why should these aspirants be debarred from fame and fortune by some illogical prejudice against publicity? The newspapers are open to these young men destined to be of service to their country, but who are prevented from placing a knowledge of their capabilities before a public eager to purchase them. Here is a field comparatively untouched, and I am very much mistaken if it does not prove a fertile soil and productive of good for the rising generation of men—and newspapers.

Successful Exhibit of a Central Station.

At a recent Canadian electric exhibition the Toronto Electric Light Company maintained a booth, thirteen by forty-three feet, that was said to be the most brilliant and beautiful booth on the grounds.

The ceiling was studded with sixty-watt tungsten lamps equipped with Holophane reflectors. On the roof of the booth there was a magnificent sign twenty feet high by fourteen feet wide, of an electric flat iron superposed by two rockets that broke into stars, flashing alternately with the words, in fourteen inch letters: "Electricity makes the Sad Iron the Glad Iron."

On exhibition in the booth were Spencer turbine-cleaners operated by five, and two-horsepower motors respectively, electrically-operated cash registers, adding machines, washing machines, portable vacuum cleaners, electric flat irons, toasters, water heaters, waffle irons, percolators, heating pads, luminous radiators, electric signs, and numerous other devices typifying the convenience and flexibility of electricity as a lighting, heating and driving agent.

The booth was tastily decorated in white and gold, rugs covered the floor and the public was invited to avail themselves of the chairs and tables where coffee and toast was served gratis. A skilled technical man was in charge assisted by solicitors and demonstrators from the sales department.

The company reports that the number of orders taken was very gratifying and a large volume of business is expected, aside from the undoubted advertising that will accure from the exhibition.

Electric Vehicles for Making Ice Cream.

In St. Paul recently, an ice-cream manufacturer, having had trouble with a local lighting company which resulted in the service being cut off employed his five electric delivery wagons to furnish current until new arrangements could be made.

The storage batteries of the vehicles were first charged to their full capacity and after being connected to the feeders of the plant, furnished sufficient current to operate the plant at its full capacity. The vehicles are of Waverley manufacture.

The Demand for More Light and the Attitude of Central Stations.

It may safely be stated that the Standard Oil Company with its system of distribution has done a great deal to stimulate the demand for better illumination.

How much more then, can the central station, with the ideal method of distribution possible with electricity, accelerate the demand for more and better light by systematic efforts to make their prospective customers see the advantages which pleasing and ample illumination, approaching daylight, will bring.

Close observers of the development of lighting units have noted that the public is striving more and more for illumination which produces the same optical sensation as daylight. While a few years ago it was practically impossible to produce such an effect at a reasonable cost the advance in construction of high-candlepower arc lamps has helped make it possible for central stations to furnish lighting units giving the desirable results referred to at a comparatively low cost.

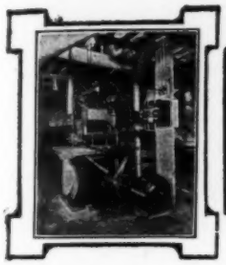
A steady improvement has been taking place in the manufacture of high-candlepower arc lamps, and central-station managers should give careful consideration to the advanced types now available before taking up a progressive campaign with a view to interesting their customers in this form of illumination. Lamps of decided merit being available, the time is ripe for the central-station manager to recognize the demand of the public.

Electric Illumination.

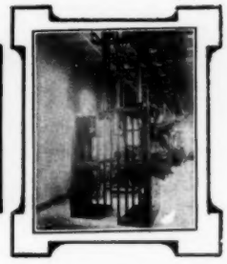
An attractive little booklet bearing this caption has been distributed by the Toronto Electric Light Company Limited, Toronto, Canada, and marks another step in the energetic new-business campaign being carried on by that company. The publication pertains particularly to store lighting with tungsten lamps.

Large Electric Sign for Pittsburg.

The Allegheny County Light Company is arranging to erect, for its own use, in Pittsburg the largest roof sign in that city. It will be located on top of the Highland Building, will measure 44 by 300 feet, and will require about three thousand tungsten lamps to illuminate it.



Industrial Power



Power Cars Wanted in South America.

An American consul in South America reports that the owner of a tramway line wants to get in touch with American manufacturers of power cars. An electric storage battery or a storage car (gasoline, petroleum, etc.), is needed to replace the steam locomotive and to accommodate about sixty passengers and with power to haul a second car of thirty passengers. The line is five and a half miles in length, three-foot gauge, uses forty-pound rails, radius of curves fifty meters, and with a maximum grade of two per cent. The height of drawhead on car is seventy-five centimeters. Particulars may be obtained by writing to the Bureau of Manufactures, Washington, D. C., quoting File No. 5426.

Ozonizers at Denver.

Those who visit Denver during the electric show in October, will be given a novel demonstration never before attempted. The largest ozonizer manufacturing house in the world will undertake to show how the air in the business section of a city can be kept pure and clean by the use of ozonizers.

Europe is far ahead of the United States in the study of ozone-making methods now extensively employed in hotels, theaters, churches, factories, offices, stores, public buildings and prifices, stores, public buildings and homes. vate homes.

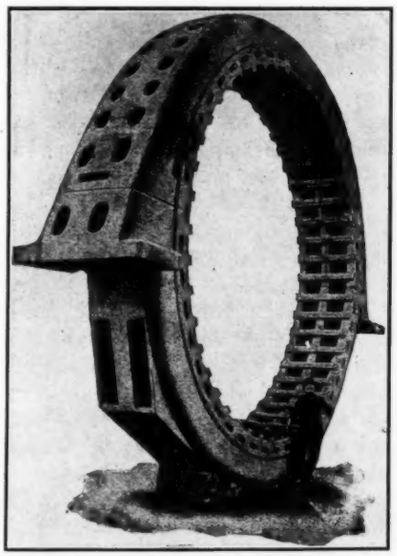
Electricity at Krupp Steel Works.

The F. Krupp Company, which is the largest steel company in Germany and which on May 1 last employed in its various works at Essen, Rheinhausen, Annen, Magdeburg, and Kiel, no less than 68,985 persons, utilizes electricity to a great extent. The cast-steel department, is supplied by six central stations, which furnish current for 3,125 arc lamps, 32,194 incandescent lamps, and 2,690 electric motors. A year's output amounted to 39,640,000 kilowatt-hours.

Large Generators for Ontario Power Company.

The accompanying illustration, which, together with the description, is taken from a recent issue of the *Canadian Electrical News*, shows one of the armature castings recently made by the Canada Foundry Company for the new generators being built for the Ontario Power Company, Niagara Falls, by the Canadian General Electric Company.

There are three of these machines, each of 12,500 horsepower, being some of the largest electric generators on this continent.



ARMATURE CASTING OF GENERATOR FOR ONTARIO POWER COMPANY.

The casting was molded and cast in one piece, in order to insure true shape, and divided into upper and lower halves by the use of cores.

Some idea of the immense size of the castings can be obtained from the illustration. The measurement across the first is twenty-seven feet, with a mean outside diameter of twenty-three feet, and being four feet wide across face of poles.

The order for these generators, it will be remembered, was rendered immediately necessary by the Ontario Power Company's contract to supply 60,000 horsepower to the Ontario Hydro-Electric Commission for distribution over southwestern Ontario and east to Toronto.

Power Plant for Rifle Factory.

The Winchester Repeating Arms Company, states a New Haven exchange, has plans ready for the construction of a large power plant to furnish power for the huge factory, and a permit has been requested from the building inspector for permission to start work. The new addition of the plant, which will be a large and important one, will be located in the block bounded by Winchester Avenue, Newhall Street, Division and Argyle Streets. The building, which is to be of brick construction, will be about thirty feet high and will be 135 by 70 feet.

The plant will contain twelve large Babcock & Wilcox boilers to be set in two rows of six each. The contract for the entire plant is in the hands of Westinghouse, Church, Kerr & Company, of New York City.

Canadian Quarry Replaces Isolated Plant by Central-Station Service.

The stone-crushing plant of the Point Annie Quarries, Ltd., hitherto operated by steam and electric power and lighted by a steam-electric supply, both from a private plant, will shortly be completely electrified and will take its power from a substation connected to the power line of the Seymour Power and Electric Company. The substation will contain two 300-kilowatt, sixty-cycle, three-phase transformers, stepping down current from 44,000 to 600 volts, as well as high-tension oil switches and other apparatus. The electrical equipment was supplied by the Canadian General Electric Company.

By a recent order all of the land along Snake River in Idaho was withdrawn from entry as power sites.

Electrification of Mines.

At a meeting of Alabama operators, mine foremen and fire bosses, held at East Lake Park, Alabama, on July 30, a paper on "Electrification of Mines" was presented by Morris Bush, of the Woodward Iron Company, Woodward, Alabama. An abstract follows: The No. 1 Dolomite mine was opened in 1882 by the Woodward Iron Company, the No. 2 mine about two years later. Both of these mines have been operated continuously since then, except for slight interruptions caused by strikes. The output has been steadily increased until now, for several years, an output of 1,000 tons per day for each mine has been maintained. As the developments in electricity have been so rapid and electric machinery has been so much simplified it was decided to introduce electric haulage and, at the same time, to avoid a double power system, to also ventilate and pump the mines by electricity.

For economy's sake the central power station was located at the furnaces and the steam is furnished from the furnace boilers generated by waste gases from the furnaces. Alternating current of 3,300 volts, three-phase, 125 cycles is generated and transmitted nearly three miles to Dolomite. For supplying the direct current to the electric locomotives, rather an innovation was introduced in the location of the substations. It was not feasible to locate the station outside, owing to the distance necessary to transmit the current, the loss and high copper cost. It was not considered desirable to locate the station above the workings and drop the line through a bored hole, because the station would have been located about two and one-half miles from the railroad and in some of the roughest country in Jefferson County. It would have been very difficult to reach to make necessary repairs. It was therefore determined to shoot out a chamber in each mine and place the rotary converters underground. The 3,000-volt current is taken down the slopes in a three-conductor cable, thoroughly insulated and steel armored. It is suspended from the roof out of reach of cars and men. In addition to these cable feeds, there is an overground line running to the fan shaft and then down to the converters. Thus there is a loop supply which will run the mines in case a fall of rock should disable the cable, or a storm cripple the outside line.

In the No. 1 mine are four six-ton locomotives and one eight-ton slope motor; in No. 2, four sixes and a ten-ton. Any four of these will keep up the output. Taking it as a fact, though, it is seldom recognized, I am sorry to say, by most mine superintendents that a track underground should be as good as a track outside. All of the mine tracks were rebuilt for the electric haulage. Sixty-pound rails were put on the slopes and thirty-pound on the headings. It is possible for the slope motors to pull their full tonnage and maintain when necessary a speed of twenty-five to thirty miles per hour. Thus it is now possible to handle sixty per cent more coal with ten locomotives, ten motormen and ten switchmen, than was possible with seventy mules and a host of drivers.

Of course the haulage was the most vital point in our conditions, but scarcely less important was the matter of drainage. We have to drain more than 2,500 acres of worked-out territory. The system used is a number of small geared pumps, throwing the local drainage to a central pumping station consisting of two triplex geared pumps of a capacity of 750 gallons each per minute, discharging through 4,000 feet of fourteen-inch main against a vertical head of 635 feet.

The ventilating problem has been wonderfully simplified by the introduction of electricity. Instead of the old paddle-wheel fan of slow speed, which took occasion periodically to shed some of its arms, it was possible to use the compact high-speed fan, mounted directly on the motor shaft. The Dolomite mines are ventilated by a large fan located at the top of air shaft in No. 2 mine, assisted by a small booster fan in No. 1.

Another great convenience in having electricity is the possibility of introducing the electric coal cutters. The art of pick mining is rapidly being lost and the miner with dynamite, shooting on the solid, is abroad in the land, menacing the mines and miners. We find the coal cutters of immense advantage, particularly where the coal has any partings that would be shot up and mixed with the coal. If our further experiments are as satisfactory as the preliminary trials we hope behind the machines to use a small electric drill and hydraulic cartridges, thus doing away with explosives in a large part of the mines.

Now, as to some of the small conveniences of having electricity readily available at all parts of the mines, it is the work of only a few minutes with a portable pump to unwater any local sag that may give trouble. It is of immense advantage in preventing accidents and delays to have all concentrating yards thoroughly lighted and all main turnout switches to show automatically whether the switch is open or closed. There is also the convenience of doing away with the expensive and troublesome storage batteries for signals and instead tap the main transmission line with a low-voltage bell-ringing transformer. Frequently it is of considerable advantage to use in a long, tight heading a small, self-contained portable fan. These can be carried around on a truck and set off at any desired point.

To sum up briefly the advantages of electricity in our Dolomite operations: In the No. 1 mine the locomotives deliver to an endless rope, driven by a variable-speed alternating-current motor, 3,300 volts. This was considered at the time more or less of an experiment in variable speeds, as the motor was so large and the voltage high. The operation, however, has been absolutely satisfactory, and we now have at the ore mines a hoist six times larger, same voltage and variable speed, working splendidly. In No. 2 mine the coal is delivered to an endless rope 9,000 feet long and one and one-half inches in diameter and taken out to the top house. This system results in (1) making available at economical cost distant coal; (2) better air and sanitation by taking out mules; (3) economical distribution of a very flexible and efficient power at small cost, available at all parts of the mine for all kinds of work.

Book Review.

"Dynamo Building for Amateurs." By A. J. Weed, New York: The Norman W. Henley Publishing Company. Cloth, 83 pages (4¾ by 7¼ inches), illustrated. Supplied by the Electrical Review Publishing Company for $1.

This is a practical treatise showing the construction and winding of a fifty-watt, experimental dynamo. The construction of each detail is considered and a number of excellent illustrations given, demonstrating clearly the different operations in construction. This book will be of great help to students in high schools and to amateurs desiring to construct a machine.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways of St. Louis, for the month of July and seven months ended July 31, 1910, compares as follows:

	1910	1909
July gross	$ 988,079	$ 943,811
Expenses, tax and depreciation	649,216	597,509
July net	$ 338,863	$ 346,302
Other income	3,949	4,429
Total income	$ 342,812	$ 350,731
Charges	233,439	232,450
July surplus	$ 109,373	$ 118,281
Seven months gross	6,593,581	6,317,487
Expenses, tax, and depreciation	4,465,557	4,028,702
Seven months net	$2,128,024	$2,288,785
Other income	21,347	22,323
Total income	$2,149,371	$2,311,108
Charges	1,634,221	1,637,079
Seven months surplus	$ 515,150	$ 674,029

LAKE SHORE ELECTRIC.

The report of the Lake Shore Electric Railway Company for the month of July and seven months ended July 31 compares as follows:

	1910	1909
July gross	$132,032	$121,185
Expenses and taxes	60,084	55,650
July net	$ 71,948	$ 65,534
Charges	34,751	33,786
July surplus	$ 37,196	$ 31,748
Seven months gross	658,759	595,862
Expenses and taxes	358,781	334,027
Seven months net	$299,978	$261,835
Charges	243,362	240,436
Seven months surplus	$ 56,616	$ 21,399

NORTHERN OHIO TRACTION.

The report of the Northern Ohio Traction and Light Company for the month of July and seven months ended July 31 compares as follows:

	1910	1909
July gross	$ 262,020	$ 227,012
Expenses	131,938	115,650
July net	$ 130,082	$ 111,361
Charges	43,357	43,391
July surplus	$ 86,726	$ 67,970
Seven months gross	1,349,355	1,200,953
Expenses	756,168	669,016
Seven months net	$ 593,187	$ 531,938
Charges	303,273	306,711
Seven months surplus	$ 289,914	$ 225,227

LONDON UNDERGROUND.

The Underground Electric Railways Company of London, Limited, has issued its report for the six months ended June 30, 1910. The consolidated income account compares as follows:

	1910	1909—
Income from investments, operation of power house, in etc.	£147,614	£119,141
General expenses, salaries, interest on bonds, etc.	121,221	135,381
Balance	£ 26,393	£*16,240
Amount payable for interest (1%), on income bonds, plus taxes	26,077	.....
Surplus	£ 315	£*16,240

*Deficit.

KANSAS CITY RAILWAY AND LIGHT.

The report of the Kansas City Railway and Light Company for the month of May and twelve months ended May 31, 1910, compares as follows:

	1910	1909
May gross	$ 615,250	$ 576,499
Expenses	391,574	327,959
May net	$ 223,676	$ 248,540
Charges and taxes	176,565	161,395
May surplus	$ 47,110	$ 87,146
Twelve months gross	7,178,440	6,629,195
Expenses	4,153,249	3,766,788
Twelve months net	$3,025,191	$2,862,407
Charges and taxes	1,911,535	1,889,742
Twelve months surplus	$1,113,656	$ 972,665

The earnings for the month of June follows:

	1910	1909
June gross	$ 617,264	$ 562,795
Expenses	373,655	323,124
June net	$ 243,608	$ 239,671
Charges and taxes	185,432	171,754
June surplus	$ 58,176	$ 67,917

GAS AND ELECTRIC COMPANIES.

The following gas and electric properties report earnings for the month of July, compared as follows:

BLACKSTONE VALLEY GAS AND ELECTRIC COMPANY.

	1910	1909
Gross earnings	$ 76,059	$ 73,396
Net earnings	36,628	33,368
Surplus over charges	6,715	3,897

DALLAS ELECTRIC CORPORATION.

	1910	1909
Gross earnings	$117,270	$103,340
Net earnings	31,797	35,233
Surplus over charges	4,955	6,830

EL PASO ELECTRIC COMPANY.

	1910	1909
Gross earnings	$ 49,351	$ 46,362
Net earnings	19,794	17,158
Surplus over charges	11,579	9,073

GALVESTON-HOUSTON ELECTRIC COMPANY.

	1910	1909
Gross earnings	$122,097	$109,747
Net earnings	56,108	47,678
Surplus over charges	29,499	26,082

LONDON UNDERGROUND.

The associated companies of the Underground Electric Railways Company of London report for the month of July, compared as follows:

METROPOLITAN DISTRICT RAILWAYS.

	1910	1909
Gross receipts	£57,951	£54,805
Working expenses	27,482	28,614
Net receipts	30,469	26,191

LONDON ELECTRIC RAILWAY COMPANY.

	1910	1909
Gross receipts	£59,085	£58,996
Working expenses	30,678	31,814
Net receipts	28,407	27,182

LONDON UNITED TRAMWAYS, LTD.

	1910	1909
Gross receipts	£31,007	£31,122
Working expenses	20,926	20,048
Net receipts	10,081	11,074

SUSQUEHANNA RAILWAY, LIGHT AND POWER.

The Susquehanna Railway, Light and Power Company has issued its report for the year ended June 30, 1910, which compares as follows:

	1910	1909
Total net earnings	$748,063	$612,362
Interest on preferred stock and bonds of subsidiary companies	249,680	247,656
Available for dividends	498,383	364,706
Preferred dividends	204,610	204,610
Surplus	*293,773	160,096
Reserve for depreciation of plant and equipment of subsidiary companies	91,669	.....
Surplus	202,104	160,096

*Equal to 7.28 per cent earned on $4,034,500 common stock, as compared with 3.97 per cent earned on same stock last year.

MEXICAN LIGHT AND POWER.

Mexican Light and Power earnings for July show a big improvement over those of the corresponding month last year, largely because the company last year was suffering from the break in the Necaxa Dam. This year's July figures show a decrease in operating expenses of $234,571. July gross amounted to $578,484, an increase of $112,994 and net earnings totaled $438,667, an increase of $347,535, as compared with the same month last year.

The report of the Mexican Light and Power Company for the month of July compares as follows:

	1910	1909
July gross	$578,484	$465,490
Expenses	139,817	374,358
July net	438,667	91,132

BINGHAMPTON RAILWAY.

The report of the Binghampton Railway Company for the year ended July 1 compares as follows:

	1910	1909
Gross	$349,186	$331,777
Expenses	200,253	193,518
Net	148,933	138,259
Interest and taxes	108,427	107,548
Surplus	40,505	30,711

KEYSTONE TELEPHONE COMPANY.

The report of the Keystone Telephone Company of Philadelphia, for the month of July, compares as follows:

	1910	1909
July gross	$ 94,472	$ 91,020
Expenses and taxes	47,422	45,533
July net	47,050	45,487
Charges	24,611	25,802
July surplus	22,439	19,685

NORTHERN TEXAS ELECTRIC COMPANY.

	1910	1909
Gross earnings	$125,943	$109,212
Net earnings	57,796	49,378
Surplus over charges	37,523	32,188

PUGET SOUND ELECTRIC RAILWAY.

	1910	1909
Gross earnings	$182,986	$184,531
Net earnings	80,782	78,487
Surplus over charges	29,491	29,979

SAVANNAH ELECTRIC COMPANY.

	1910	1909
Gross earnings	$ 59,140	$ 55,812
Net earnings	18,197	17,565
Surplus over charges	5	121

SEATTLE ELECTRIC COMPANY.

	1910	1909
Gross earnings	$459,059	$592,587
Net earnings	197,550	287,559
Surplus over charges	87,175	178,857

New Electrical and Mechanical Apparatus and Appliances.

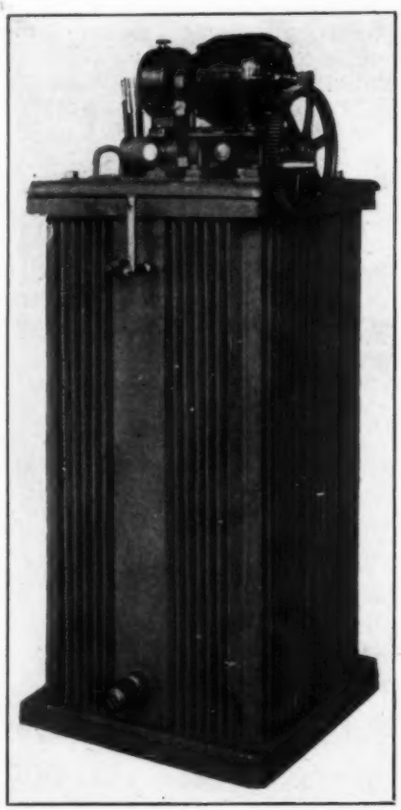
Westinghouse Induction-Type Potential Regulators.

The motor-operated single-phase inducton regulator shown in the accompanying illustration embodies the several improvements recently made in this line by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Although the general design of these regulators remains unchanged, modifications have been made that insure not only a higher degree of satisfactory operation but longer life.

The skeleton-frame construction of the new type single-phase potential regulator permits the use of a "cast-in" corrugated sheet-metal tank which affords a larger and more efficient radiating surface than the cast-iron tanks used with the earlier regulators, thereby insuring a low operating temperature. This type of tank is also less liable to give trouble from oil leakage, which some times occurs with the cast-iron tanks on account of unavoidable defects in the castings. In the latter, the leaks usually developed after the punchings and windings had been placed in position, thus causing considerable loss of labor in the work of rectification, while it is noteworthy that in the case of the "cast-in" tank a defective tank entails no other loss than the tank itself. In the earlier designs the cast-iron tank was bored out to receive the stator punchings. As this tank was open only at the top, difficulty was sometimes experienced in obtaining an inner cylindrical surface which would be in perfect alinement with the rotor bearings located in the cover and bottom of the tank.

Up to and including the ninety-five-kilowatt size, the polyphase regulators have "cast-in" corrugated sheet-metal tanks. They are similar to and possess all the advantages of the "cast-in" type of tank. They possess great strength mechanically, have large radiating surfaces and dirt and dust-proof qualities. An oil gauge at the top and a valve as oil drain at the bottom are provided. The regulator is shipped assembled in its case. Above ninety-five kilowatts the regulators are usually oil-insulated and water-cooled. Boiler-iron cases with cast-iron bases and covers are usually used.

The single-phase regulator has a tendency to vibrate, but this has been overcome, it is said, in the Westinghouse regulator by careful design of the bearings and shaft. The moving element is carefully centered so that a uniform air gap is secured. Furthermore, the tendency to vibrate is reduced, due to the low point on the saturation curve at which the magnetic circuit of the regulator is worked. A very agreeable result of the elimination



WESTINGHOUSE INDUCTION-TYPE POTENTIAL REGULATOR.

of the vibration is the noiseless operation of the regulator.

Treasury Department to Have Electric Protection System.

The contract for installing electric protection to entrances and vaults in the United States Treasury Department, Washington, D. C., has been awarded to the Bankers Electric Protective Association, of New York city, at $10,220. The work will be started in a short time.

THE FLAMING ARC LAMP: ITS ECONOMY OF INSTALLATION A BIG FACTOR IN ITS FAVOR.

BY L. J. AUERBACHER.

The highly efficient and economical flaming arc lamp has lately been coming rapidly into favor as an illuminant for large indoor areas and for outdoor uses as well. The fact that it gives a light equal in intensity to ten enclosed arc lamps of the same type, or the equal of 200 carbon incandescent lamps, is a great point in its favor, and for installations where a single unit of lighting system is required or desired it is especially well fitted.

The flaming arc is caused largely by the luminescence of the electrodes, and also by the evaporation of metallic salts contained in these electrodes due to the great heat of the arc. In the case of the yellow light, salts of calcium are used. Owing to the fact that intense heat is required to vaporize these salts, the electrode must be of comparatively small diameter and consequently have a short life.

As the arc voltage is about forty to forty-five volts and the terminal voltage fifty-five to sixty, the difference being taken by the balancing resistance, solenoid and blowout magnet, two lamps are operated in series on 110 to 120 volts. On direct current, should it be desired to operate only one lamp on 110 volts, a resistor having sufficient resistance to dissipate 550 watts continuously, without damage to its coils, is connected in series with the lamp.

On alternating-current circuits a small auto transformer is used to reduce the voltage to fifty-five volts. Consequently single lamps can be operated to advantage on 110-volt alternating-current circuits, taking only half the wattage of two, plus the iron and copper loss in the auto transformer, which is about fifty watts.

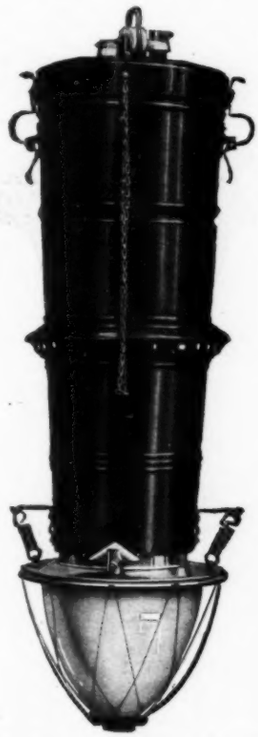
It is primarily the great efficiency of the flaming arc which has caused its rapid introduction in mills and railroads. Taking fifty-five volts and ten amperes (550 watts), the "Hawthorn" flaming arc gives about 3,000 candlepower, or approximately .02 watt per

candlepower as compared with two watts per candlepower of the enclosed arc.

Another factor which has aided its rapid introduction is the quality of the light rays. The golden yellow light is very pleasing and not tiring to the eyes, and consequently night gangs can work almost as well under this light as daylight.

One prominent steel mill proved conclusively that the output of its departments using this light was increased at least ten per cent, quite a large item, and one which paid for the lamps in a few weeks.

Another factor which has helped the sale of flaming arcs is the economy of



HAWTHORN FLAMING ARC LAMP.

installation. As only one outlet is required for 3,000 candlepower, as against five to ten for the same amount of light of the enclosed arc, the initial saving in wiring pays for the lamps. Where the comparison is made with incandescent lamps, the difference in favor of the flaming arc is also noticeable.

In many plants which are now overloaded, the substitution of flaming arcs not only will give more and better light, but will relieve the overload and make available enough additional kilowatt capacity of generators, so that the installation of the flaming arc lamps means a positive saving in first cost of equipment.

The development of the flaming arc has naturally been a series of evolutions and corrections of defects brought out by practice. As the first commercial lamps were brought out in Germany, the complicated German differential mechanism was adapted to control the converging carbons. Notwithstanding the high state of perfection these clockwork lamps are brought up to, American engineers have not taken kindly to them, and justly so, owing to the trouble to make repairs and adjustments. It takes specially trained instrument men to calibrate a pair of lamps (they are adjusted in pairs when used in series on 110-volt circuits).

The principle of the Hawthorn flaming arc lamp, manufactured by the Western Electric Company, is that a carbon when supported at the arc will slowly burn away at the point of support, gradually sink down and thereby feed, without burning away the support. The carbon thus supported has a rib or projection which rests on the support. The other carbon being coupled with it sinks down at the same rate, consequently both carbons burn off evenly, tending to steady light.

Another advantage of this method of feeding is that the arc is always in the same plane of the economizer and consequently gets a uniform supply of oxygen during its entire run. Therefore Hawthorn flaming arcs always give the maximum burning hours, thereby saving carbons. Differential lamps often overfeed, consequently the carbons extend down in the economizer, and get too much oxygen. They therefore burn off quickly and the average life of the so-called seventeen-hour differential lamp is about fourteen hours. In winter, when often sixteen hours' burning is required, this fact will cause trouble, especially in mills and railroads. A considerable money loss is caused and accidents can easily occur.

The simplified Hawthorn flaming arc mechanism enables the alternating-current lamp to operate equally well on any frequency from twenty-five cycles to 133 cycles. The success of the twenty-five-cycle lamp has given the engineer of large transmission systems the use of the most efficient artificial light and has solved many an illumination problem, owing to the scarcity of lamps which would operate on this low frequency.

McDonnell Ornamental Posts.

The effectiveness of ornamental street lighting has been convincingly demonstrated in the numerous instances in which it has been employed. Installations of this character are being made in practically every progressive city, regardless of its size, and in cities where initial installations have been made reports of extensions are numerous.

To be effective, however, many conditions must be considered, and it is only by selecting the proper materials and by scientific designing that the best

McDONNELL STANDARD—CROWN TYPE.

results are obtained. In this connection the type of post or standard used is of decided importance.

Two of the accompanying illustrations show two types of street standards, manufactured by the McDonnell Iron Works, Des Moines, Ia., which are meeting with much success. These poles are all made to template, thoroughly machined and a very substantial design in every respect. The height, spread of the arms, etc., are from the dimensions figured out by the company's competent engineers to give the best service.

The two standards shown herewith are of the Crown and Imperial types respectively. Among the notable in-

McDONNELL STANDARD—IMPERIAL PATTERN.

stallations of the former pattern may be mentioned Des Moines, where over 300 poles are installed. Other installations of both Crown and Imperial types include the towns of Adel, Albia, Algona, Ames, Boone, Charles City, Clarinda, Creston, Estherville, Grinnell, Indianola, Mason City, Winterset and Marshalltown, all of Iowa. A night view of Main Street, Marshalltown, is shown herewith.

NIGHT VIEW OF MAIN STREET, MARSHALLTOWN, IA., WHERE McDONNELL POLES ARE USED.

Telephone Reform in Boston.

A radical revision of telephone rates in Boston has been recommended by the Massachusetts Highway Commission, which has supervision of the telephone companies. The plan of the commission includes confining unlimited service at a flat rate to zones, the metropolitan district forming one zone, and the suburban zones including the subscriber's own exchange and the contiguous suburban exchanges.

Other recommendations are: That five-cent tolls be extended to eight miles; that ten-cent tolls be reduced to five cents from outlying suburban exchanges to contiguous outside exchanges within five miles, and that two-party lines, with divided ringing, be substituted for multi-party lines.

National Brake and Electric Company Builds.

The National Brake and Electric Company, Milwaukee, Wis., has been issued permits to add additional buildings to its present plant. The plans provide for a $70,000 machine shop and a $40,000 warehouse.

The machine shop dimensions will be 186 feet by 247 feet and the dimensions of the warehouse will be 186 feet by 140 feet. Both structures are to be constructed of fireproof stone and brick.

Fixtures for Indirect Illumination.

The eye comfort system of illumination has created for the fixture manufacturers a field for prospective business which should not be overlooked. The National X-Ray Reflector Company, Chicago, Ill., who has been prominently identified with the development

ONE TYPE OF INDIRECT LIGHTING FIXTURE.

of this system, although realizing the possibilities of the lighting and fixture field has evinced no disposition to attempt to control the fixture end of this method of illumination, but announces

NEW ONE-LIGHT UNIT.

that it is working in harmony with and through the fixture manufacturers and dealers. In fact, the company states

that it has refused to sell to the consumer direct and in no instance has done so except at first in a few instances for advertising purposes, which has invariably been as much to the in-

NEW 250-WATT UNIT.

terest of the dealer as to the manufacturer.

Maintaining an engineering department, the company, without expense to the fixture manufacturer or dealer, designs fixtures for any interior where ceiling conditions are favorable to indirect illumination, furnishing the fixtures and appliances necessary for such

SIXTY-WATT UNIT.

installations complete or in part as desired.

The fixtures shown here are some of the new standard designs it has developed that can be furnished in parts or complete if the manufacturer so desires. This is for the convenience of the fixture manufacturer or dealer who broadening his line desires standard stock. In instances where the consumer desires something exclusive it necessitates the designing of special fixtures on the manufacturer's part to meet the taste of the purchaser. This system lends itself to a great variety of artistic designs.

National Shock Absorbers.

It is unquestionably true that the life of a tungsten lamp will be greatly pro-

COMPOSITE FIXTURE.

longed when suitable shock absorbers are used. This is particularly true in installations where the lamps are subjected to more or less severe vibration, for, although noticeable improvements have been made in the mechanical construction of tungsten lamps, their filaments are still comparatively fragile.

The accompanying illustrations show three types of shock absorbers, which in several notable installations have demonstrated conclusively that they fulfill the requirements imposed upon them. Among these installations may be mentioned several stores located directly over a subway where the vibration was very noticeable every time a train passed. Another installation was in a club room directly under a dance hall, where supplementary gas lamps were, on numerous occasions, totally destroyed without injuring the tungstens equipped with shock absorbers.

FIG. 1.—TYPE A SHOCK ABSORBER.

The absorbers are known as the National shock absorbers, and are manufactured by the National Electric Equipment Company, 15 Beacon Street, Boston, Mass.

In Fig. 1 is shown the type A absorber, designed for use with fixtures. The spring is so wound that it will take care of all vibration on lamps from twenty-five watts to 100 watts.

FIG. 2.—TYPE C.

Fig. 2 illustrates type C absorber, which is designed for use on fixtures and is intended to be placed inside of the canopy, three-eighth-inch thread being furnished on each end. The spring is so wound as to give satisfactory results on fixtures weighing three to nine pounds.

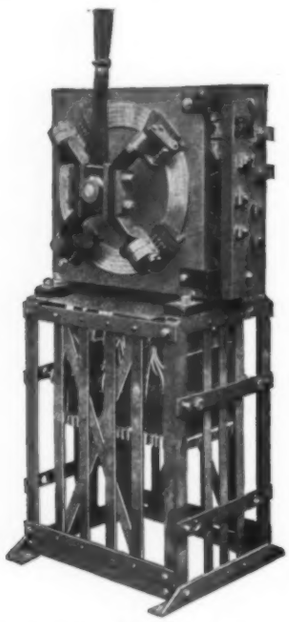
The National shock absorber de-

FIG. 3.—TYPE B.

signed especially for millwork where there is a constant vibration, is shown in Fig. 3, known as type B. This absorber is made to fit any lamp up to 250-watt size.

Crane Controllers for Alternating-Current Motors.

Alternating-current systems are now common in the large industrial plants. This has led to the application of alternating-current motors for purposes which until recently were only accomplished by direct-current motors. Crane operation has long been known to be best accomplished by the direct-current motor, but lately the slip-ring induction motor has presented advantages which make it preferable in some cases. When provided with proper controlling apparatus its use is now practicable, and in plants having alternating-current systems the expense



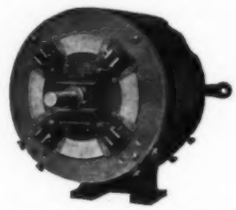
ALTERNATING-CURRENT CRANE CONTROLLER.

of installation and operation of a motor-generator set is saved.

Realizing the necessity for alternating-current controlling apparatus for crane service, the Cutler-Hammer Manufacturing Company, Milwaukee, has developed a line of crane controllers for alternating-current motors. In appearance they are similar to the direct-current faceplate-type crane controllers made by this company. The front and rear views of two types for use with slip-ring motors are shown in the accompanying illustrations.

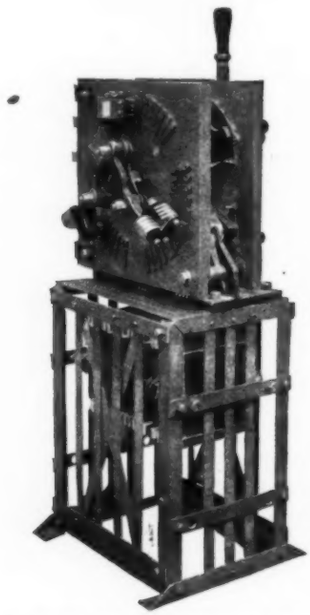
In the small sizes the resistance is mounted directly on the rear of the face, making the device self-contained and compact. For small cranes they are very convenient and can be operated by means of ropes from the floor.

For the larger controllers the grid resistance is mounted below the face plate. The straight lever motion al-



REAR VIEW OF CONTROLLER.

lows easy operation and permits the installation of several controllers side by side. These controllers can be located at the rear or outside of the cab and



REAR VIEW OF ALTERNATING-CURRENT CRANE CONTROLLER.

are operated by means of a bell crank and link arrangement, if desired. The structural steel construction provides a strong and light frame and permits

SELF-CONTAINED CRANE CONTROLLER.

easy inspection. Careful design and rugged construction are apparent in every feature and detail of these devices. The arrangement of the contacts insures accurate control. The segments can be replaced and interchanged very easily.

Squirrel-cage induction motors are not adapted for crane work except in unusual cases. However, crane controllers for use with this type have also been developed.

Hughes Electric Stove.

The accompanying illustration is a view of a new type of electric stove manufactured by the Hughes Electric Heating Company, Chicago, Ill., known as range No. 30.

This stove, while of pleasing appearance, is rigidly constructed and embodies many features worthy of note. The body is made of blue steel; the top is cast and polished with nickel-plated edges; the legs are cast and nickel plated. They have an extended flange forming a pocket into which the steel body sets, and when bolted holds the range firmly and securely in place.

VIEW OF HUGHES THREE-BURNER ELECTRIC STOVE.

The stove is built with three burners, each capable of being regulated to three heats, high, medium and low, consuming 880, 440 and 220 volts respectively. The heat for each burner is controlled by a three-heat switch.

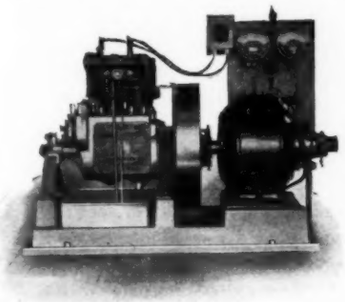
The oven has two heating units, one located in the top and the other in the bottom, each consuming the same amount of current and controlled in the same way as the top burners. The oven is highly insulated and, according to the manufacturers, will keep food hot for a long period.

Following are a few of the advantages of the electric oven: No appreciable increase in the temperature of the air in the room where the oven is in operation; no annoyance due to unsteady or uneven heat; absence of escaping gases, coal dust or soot.

The Brush Electric Lighting Set.

With the advent of the fall months, there comes to many manufacturers the realization that their power plants are inadequate for the additional load needed for lighting purposes.

Up to the time last spring when the necessity for shop or office lighting ceased, the power plant had likely been worked up to its full capacity. During the summer a machine, or a few machines, may have been added, not enough to worry about at the time, but just enough to take the power which



BRUSH LIGHTING SET.

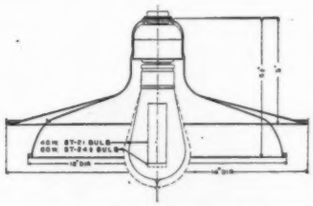
is now—or soon will be—needed for lighting.

To procure boilers and engines takes considerable time; to install them more time; and, perhaps worst of all, in many instances the room for such additional steam power, either boilers or engines, or both, is not available.

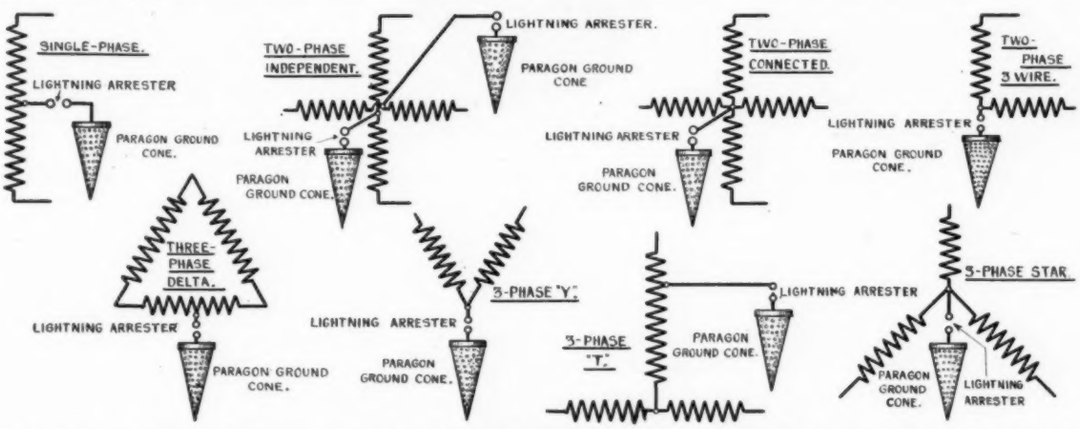
In many cases the Brush electric lighting set, shown here, is particularly adapted for such emergencies. The floor space required is only 2 by 5 feet. The fuel used may be gasoline, kerosene, natural or artificial gas. Regulation is as good as that obtained by any standard steam engine, and while its capacity is but ten horsepower, it is, by reason of the new metalic-filament lamps, the full equivalent of a twenty-five-horsepower engine using carbon-filament lamps. The sets are shipped on short notice ready for immediate installation. The Chas. A. Strellinger Company, Detroit, Mich., is the manufacturer of this lighting set.

The Paragon Ground Cone.

The accompanying illustration shows the wiring connections of the Paragon ground cone applied to polyphase transformers, only the low-tension windings being shown. In connection with the impetus which is being accorded the grounding of secondaries it may be said that the Paragon ground cone has successfully met the requirements of a permanent ground. The simplicity of connections and the wide application of the cone is apparent in the accompanying view.



OUTLINE OF BENJAMIN REFLECTOR SOCKET.



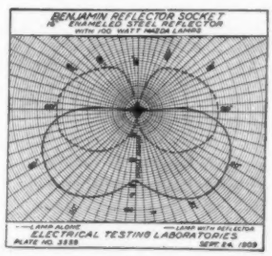
PARAGON GROUND CONE APPLIED TO POLYPHASE TRANSFORMERS. LOW-TENSION WINDINGS ONLY ARE SHOWN.

The Paragon cone is made of pure copper having seventy-five perforations to the square inch. It is filled with charcoal and equipped with a hollow copper cable running its entire length and securely soldered to the pointed tip, which is itself pure copper. The perforations in the cone permit the charcoal to absorb moisture from the surrounding earth and also give numerous points of discharge in cases where high amperage, high voltage and high-frequency currents have jumped the arrester or spark gap.

The Paragon ground cone is supplied by the Paragon Sellers Company, 48 Fifth Avenue, Chicago, Ill.

Benjamin Reflector Sockets.

The accompanying illustrations show several types of reflector sockets being manufactured and placed on the market by the Benjamin Electric Manufacturing Company, Chicago, Ill. Since the almost universal adoption of tungsten lamps, particularly for interior lighting, the demand for suitable reflectors to obtain the maximum efficiency of these units has been marked. While the Benjamin reflectors are applicable to carbon-filament-lamp installations, they have been designed primarily for use with tungstens, and in this connection have several successful installations to point to.



DISTRIBUTION ABOUT A MAZDA LAMP, EQUIPPED WITH REFLECTOR SOCKET.

Benjamin reflector sockets primarily have deeply-hooded enameled-steel reflectors with threaded brass bushings tightly clamping the reflector between two leather washers, and a specially designed two-part porcelain receptacle. As shown in the accompanying diagrams, the reflectors are of two general

types, namely, flat cone for wide distribution and bowl-shaped for concentrated distribution.

The hooded portion varies in depth to accommodate three kinds of lamps, carbon and short base; skirted base and large base. Thus reflectors suitable for any intended distribution are available.

Central-Station Development.

In a good many instances when the manager of a central station is approached with the suggestion that possibly one of the reasons why business is not growing at a rate comparable with the development in the industry is that sufficient care is not given to the matter of exploiting what the company has to deliver, he will feel his ability as an all-around man is being questioned. The central-station manager will often feel that he is capable of taking care of all departments of the central-station development, even to the matter of creating greater interest on the part of his public in the central-station proposition. It is a delicate matter to convince the manager that in some directions he may be greatly benefited by expert advice and indeed show his real cleverness in accepting the dicta laid down by those whose business it is to supplement the manager's efforts in the proper directions.

It is for the purpose of bringing to the assistance of the managers of central-station companies expert supervision of their new-business departments that the Central Station Development Company, of Cleveland, Ohio, has been organized. The staff of this company is comprised of men who are experts in their several lines and who have been selected for their special training and ripe experience in the work under their control. The service offered by the company is divided into several classifications and contemplates everything from the complete supervision of all the departments of a central station down to the preparation of preliminary correspondence for the development of a very small campaign. The company's greatest success has been in attacking the off-peak possibilities and it is well fortified in its reputation behind the tangible results which it has brought to numerous central stations throughout the country. A handsome book has just been published by the company which explains in detail the classification of service and the departments of the organization.

The G. W. Armstrong Company.

Chicago is generally recognized as the mercantile metropolis of the West, the distributing point for vast volumes of products that are shipped daily to the central and western states. It is therefore fitting that enterprising firms desiring to establish a permanent foothold in this productive territory should have headquarters, or at least representation, in so desirable a locality, where shipping facilities are nowhere excelled, and where opportunity is offered the manufacturer to become more closely associated with his customers.

In this connection it is interesting to note that the G. W. Armstrong Company, of Chicago, has been formed to manufacture and handle standard electrical specialties. Announcement has already been made that the Chicago business of the Kuhlman Electric Company, of Elkhart, Indiana, manufacturers of transformers, and Dossert & Company, of New York, manufacturers of switchboard terminals and lugs, has been taken over by this company. It is also at the present time manufacturing the new Acco lamp hanger, which embodies several unique and advantageous features, and which promises to be favorably received by the trade.

GEORGE W. ARMSTRONG.

The president and general manager of the company is George W. Armstrong, well known in the West as the western manager of the Excello Arc Lamp Company of New York. Mr. Armstrong during the few years of his business career in Chicago has established a reputation as a straightforward, successful business man, and a large share of the success of the flaming arc lamp in the West has been due to his aggressive policy in convincing others as to the merits of this type of lamp. Mr. Armstrong is a native of Ohio, in which state he received his education. That he is a man of marked initiative was demonstrated by his early desire to go out into the world and earn a living. At the age of twenty he was made manager of a business employing a number of men, and in this capacity, as well as in other similar ones, he achieved well earned success. Later, in 1906, he desired to enter new fields, and being greatly impressed with the opportunities offered by the flaming arc lamp, Mr. Armstrong became associated with the Excello Arc Lamp Company, of New York, in the capacity of sales manager and agency organizer. In this position he had an opportunity to demonstrate his aggressiveness, and his rapid success led to early promotion to district manager with headquarters in Columbus, Ohio. In February, 1908, as a reward for his earnest work, he was sent to Chicago to open the western office. Since that date he has been closely identified with the marked success of the Excello lamp, being instrumental in having in the neighborhood of 10,000 flaming arc lamps installed in that territory.

Associated with Mr. Armstrong in the G. W. Armstrong Company is H. Caird, also connected with the Excello company in the capacity of engineer. He will assume the duties of vice-president and engineer in the new company. Mr. Caird received part of his education at Massachusetts Institute of Technology and has had considerable experience in electrical work. He has associated with the General Electric Company at Lynn, Mass., for three years. Later he became superintendent of the Macon Light and Railway Company of Macon, Ga., and was later associated with the General Electric Company, at Chicago, as manager of the railway supply department.

Both Mr. Armstrong and Mr. Caird will continue to act in their respective capacities for the Excello company, continuing in every respect the well known policy of that company, and they will be located as formerly at 617 West Jackson Boulevard, Chicago.

Business of the Allis-Chalmers Company in August showed no diminution in demand for any of the lines of machinery which the company produces, according to current reports.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, AUGUST 27.—The gas companies in London have been indulging in one of their periodical campaigns in the daily papers as to the victories in ousting electricity from the streets of London, but letters are appearing from the electricity-supply companies pointing out what a very small proportion of the total number of lamps are lighted by gas. Emphasis is also being placed upon the fact that in at least three London boroughs, where the electricity works are in the hands of the municipalities, every gas lamp is being displaced. In all cases the old gas lanterns are being used, metal-filament lamps and fittings being placed in them. The figures of conversion are working out remarkably low, and in Marylebone, in sharp contrast to those areas where gas is being burned, the electricity is actually being supplied at schedule rates, and yet both the borough lighting account and the electricity undertaking are making good profits. In Westminster, where the gas companies have displaced sixty-six arc lamps out of a total of many hundreds, it has been calculated that the price of gas has been put in at about fifty per cent below cost for the sake of getting the job and the advertisement which it affords.

The accounts of the Pacific Cable Board for the year to March 31, 1910, show the usual heavy loss, this time amounting to some $300,000.

A short while ago the Postmaster General initiated a system of telephoning telegrams addressed to subscribers on the telephone system. Although the arrangement has not been in use very long it has proved very successful, and it has been decided to extend the facilities to a larger number of offices.

In consequence of the passing of the Electric Lighting Act of last year, which considerably modified the legislation relating to the electrical industry, the Board of Trade has issued some new regulations concerning applications for electric-lighting powers. It had been the practice in past years for municipalities to obtain these powers without any intention of putting them into force, and solely with the object of preventing competition with municipal gas, in many cases. Thus the inhabitants were deprived of the opportunity of having electric lighting at all. In more recent years when powers were granted, a stipulation was made by the Board of Trade that they should be put into force within a certain period, say two or three years. Under the new regulations, however, anyone applying for electric-lighting powers for a particular district has to bring forward all the details of an actual scheme with an expert report on it.

The Newcastle tramways engineer and some members of the Tramways Council are actively engaged in surveying a route for the installation of the trackless trolley system. At Weymouth, a watering place on the south coast, which at present has no means of street locomotion, the use of the trackless trolley system has been discussed, but has been finally put aside as being too much of an experiment. Tramways are to be installed.

With the near approach of the absorption of the National Telephone Company by the State, the position of the company's staff is occupying a good deal of attention. There has been a certain vagueness about the Government's intentions in this matter, although certain promises were made a few years ago that all the staff, with the exception of those earning $3,500 per annum and upwards, would be taken over. Quite recently, however, the Postmaster General has made the public announcement that the Government will retain all the staff of the Company with more than two years' service, excepting those highly paid officials mentioned above.

Following the rumor last week of considerable extensions of railway electrification in the Manchester district, comes the definite statement that the Lancashire & Yorkshire Railway will undertake large extensions of their electric lines in the Liverpool district. This company's electric line between Liverpool and Southport has been a sound financial success. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., SEPTEMBER 3.—According to the announcement of the chairman of the Ontario Hydro-Electric Commission, electric power will be turned on everywhere throughout the district served by the Commission about November 15, and prices of electricity will be cut in two.

Work that will involve an outlay of $60,000 has been started in the development of the Ottawa municipal electric plant. Contracts have been let for the new power conduit to carry power from the Chaudiere Falls to the city. The city's electric light and power plant is in a prosperous condition.

Trouble is threatened between the Canadian Light, Heat and Power Company, of Montreal, the rival of the Montreal Light, Heat and Power Company, and the Montreal Cotton Company over power privileges at the Beauharnois canal. The Canadian Company is developing there, and the Cotton Company claims that its rights and leases are being prejudicially affected. In the meantime the Dominion Government has ordered the Canadian Company to stop work until its plans are studied.

Doubt is expressed in well-informed and official circles here, if the International Waterways Commission, as at present constituted, can pronounce upon the scheme for damming the St. Lawrence River, at the Long Sault Rapids. The project has been before that body for many months, and numerous hearings have been devoted to it. The commission has never yet reported, and it may not do so at all.

Reports to the Department of Public Works here with reference to the projected waterway from Edmonton to Winnipeg are to the effect that 80,000 horsepower can be harnessed at Grand Rapids, where the junction with Lake Winnipeg is made. It is stated that this power is capable of development without difficulty, and that in addition to stimulating local industry it would be quite easy to transmit the electrical energy to Winnipeg. Preliminary reports of the waterway scheme, from the eleven parties now in the field, are expected for the coming session of the Canadian Parliament.

Montreal financial circles are just beginning to realize that one of the biggest deals in the history of that city is nearing consummation. For some time past representatives of the Canadian Light and Power Company have been buying Montreal Street Railway shares with a view to securing control of the road. That they have secured such control is stated to be a fact. The Canadian company has a power plant at Beauharnois, Que., capable of supplying over 100,000 horsepower per annum. The company has leased the Beauharnois canal from the Dominion Government for sixty-three years, on condition that it expends $4,000,000 upon it. The company is able to supply power at a much lower rate than its rival, the Montreal Light, Heat and Power Company. W.

MEXICO.

(Special Correspondence.)

MEXICO CITY, MEX., SEPTEMBER 1.—The Mexico Tramways Company, the Canadian concern which owns the hydroelectric plant at Necaxa and the extension system of electric railways in this city and the federal district, has just been granted concessions by the Federal Government for the construction of two electric interurban lines. One of these proposed roads is to run between this city and Puebla, a distance of 129 miles, and the other between here and Toluca, thirty-two miles. These two lines will be the longest electric railways in Mexico. The company made a survey for the proposed line to Puebla some time ago. Its engineers made a thorough investigation of the route and their report was favorable. Both lines will penetrate a region that is famous for its mountain beauty. The Mexico City-Puebla road will pass between the volcanoes of Popocatepetl and Ixtaccihualt. The concessions require the roads to be finished within ten years, but construction work will be started in a short time and the two lines will probably be finished in less than three years.

The Copper Queen and El Tigre mining companies have entered into a contract by which the mines of El Tigre Company and the town of El Tigre situated adjacent thereto are to receive electric power from the large generating plant of the Copper Queen Company at Douglas, Ariz. The Mexican Government has granted a concession for the construction of an electric transmission line to El Tigre from the international border line. This power cable will be fifty miles long. The survey for the route of the proposed line has been made and the construction material ordered. D.

IMPORTANT DEVELOPMENTS.

POWER FROM THE STURGEON RIVER.—A. C. McMillan, president of the Range Power Company, states that it is his intention to install a 6,000-horsepower hydroelectric plant on the Sturgeon River. The contemplated development, which involves taking power at the Little Sturgeon Falls will cost approximately $1,000,000. A narrow-gauge on an electric railway may be included in the plan.

TO BE THIRD LARGEST PLANT IN NEW ENGLAND.—A plan has been submitted to the Board of Trade of Skowhegan,

Me., outlining a scheme for making at that place the third largest water power plant in the New England States. The idea involves merging the several power rights, as now established by deed, into one new corporation, the issue of $1,000,000 first-mortgage five-per-cent bonds, and the expenditure of the proceeds in acquiring necessary property to build new dams, canals and power stations. These changes would deliver the entire normal flow of the Kennebec River under a working head of forty feet, and generate about half a million dollars worth of power each year.

BLEWITT'S FALLS PLANT TO BE COMPLETED.—The development of the electric power at Blewitt's Falls, near Wadesboro, N. C., on which about $2,000,000 was spent prior to the legal entanglements of the concern behind the development, is now said to be in a sure way towards completion. This is made possible through the efforts of the reorganization committee, and a mortgage given by the committee of the Rockingham Power Company to the Old Colony Trust Company, of New York, has been filed in the requisite counties, which will place additional funds at the disposal of the company for completing the work. It is stated that in the neighborhood of $1,500,000 will be required and expended on the hydroelectric development at Blewitt's Falls, and that this will complete this plant, which is conceded to be one of the largest and best in the state, some 20,000 horsepower being available at the falls of the river. Active work looking towards the completion of the enterprise will be begun soon, according to the latest reports from this development. L.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The New York Public Service Commission, Second District, has received an application from the Municipal Gas Company of Albany for permission to exercise a franchise granted to the applicant by the municipal authorities of the town of Bethlehem, Albany County, for the erection and maintenance of necessary appliances and apparatus for the serving of electricity for light, heat and power along the River Road (Albany and Greene Turnpike) in that town. The extension is to begin at the city line of the town of Coeymans and upon and along all public roads and highways intersecting for a distance of two miles westerly from the said River Road. It is stated that the district sought to be served is not now supplied with gas and electricity and that the petitioner has over twenty-five pending applications from persons therein for such service. The minimum rate is to be two dollars per month for such current.

Some idea of the magnitude of New York's undeveloped water power resource is given in a pamphlet prepared by the State Water Supply Commission for distribution in connection with the exhibit to be made by the commission at the State Fair in Syracuse. The commission strongly urges the enactment of legislation which will make possible the development by the state of those resources on reasonable terms. The commission says:

"With the realization on the part of the state of the enormous value of its water resources there has arisen a determination to hold them for the benefit of all the people. This policy, strongly urged by Governor Hughes in 1907 in his first annual message to the legislature, was adopted in that year. Results already reached indicate that, excluding the Niagara and St. Lawrence Rivers, which are international streams, less than half the water power that the state is capable of producing has been developed. The figures are as follows: Water power now in use, 620,000 horsepower; water power undeveloped, 880,000 horsepower; total possible development, 1,500,000 horsepower."

"What the development of the waste power would mean under the reasonable plan proposed by the Commission may be shown as follows: Annual rental value of waste power (at $5.00 per horsepower), $4,400,000; annual interest and operating charge, $3,000,000; annual net revenue to the state, $1,400,000; additional population supported, 1,000,000.

"For the development of its resources of its water power, it is proposed that the state shall authorize the issue of bonds to the amount of $20,000,000, every dollar of which, with interest, is to be repaid from the proceeds of the sale of the power produced. And when the work has been completed and paid for, it is estimated, as shown above, that the development will yield a large permanent income to the state."

The Public Service Commission of New York assumed jurisdiction over the operations of telephone and telegraph companies operating in New York State September 1. All telephone companies, corporations, associations, partnerships or persons owning or operating any telephone line in the state for profit, whose property is in excess of the value of $10,000, will come under the jurisdiction of the commission. All telegraph companies, however, are within the jurisdiction of the commission.

The new law is very similar to that which has been in force during the last three years concerning other public service corporations. Telephone and telegraph companies are required to afford adequate service at just and reasonable rates and discrimination in favor of any particular person or corporation and in giving any unreasonable preference of any kind is prohibited. No free or reduced service or free pass or frank can be given except to the employes of the corporation and their families and persons engaged in certain lines of charitable work. The corporations are required to file with the commission schedules showing rates, rentals and charges for services, also all contracts and agreements in writing between companies affording telephone and telegraph service relating in any way to construction, rentals or use of lines of telephone or telegraph companies. The companies are required to file each year an annual report which is a public record and may be examined at the office of the commission upon request.

Out of about 1,200 telephone companies in this state 115 will come under the jurisdiction of the commission.

LIGHTING AND POWER.

(Special Correspondence.)

MALVERN, IOWA.—A ten-year franchise has been granted to the electric light company. C.

TACOMA, WASH.—The city has passed an ordinance providing for the construction of a substation to cost $104,000. A.

BRAINERD, MINN.—The city council is planning to secure power for an electric light plant from Little Falls, Minn. C.

WEBSTER CITY, IOWA.—F. A. Bonebright is agitating the construction by the city of a dam across the Boone River. C.

KANKAKEE, ILL.—The Kankakee Gas and Electric Company recently increased its capital stock from $5,000 to $850,000.

TAYLORS FALLS, MINN.—The Minneapolis General Electric Company has commenced the construction of the steel towers for its pole line.

PAYNESVILLE, MINN.—The village council let the contract for the rebuilding of the power house at the light and water plant for $4,800. C.

BELLEVILLE, KANS.—The lighting plant which was was recently burned a short time ago is now being repaired. It will soon be in operation.

VENTURA, CAL.—It has been voted that this city shall have a municipal electric lighting plant. Construction work will commence early in October. A.

SOMERSET, WIS.—The Consumers Power Company, of Stillwater, Minn., will start work at once repairing its dam and power plant on the Apple River. C.

ST. PAUL, MINN.—A franchise has been granted to the electric light company in West St. Paul, and work on the extensions will be commenced at once. C.

IRONWOOD, MICH.—A new light, water and street railway company has secured a ninety-day option on the properties of the Twin City Electric Company in this city.

NEW CONCORD, O.—Work on the installation of the new electric light plant has been started. Power will be furnished to the city as well as to numerous business houses.

DETROIT, MICH.—The Detroit Edison Company has been given a ten-year contract to supply electrical power for the new Detroit River tunnel of the Michigan Central Railway.

CADILLAC, MICH.—The plant of the Cadillac Water and Light Company burned recently from a presumably incendiary cause. The loss, of $12,000, was completely covered by insurance.

GOLDFIELD, NEV.—The Pacific Hydro-Power Company, which is now installing a power plant near Mono Lake, will extend its service to the Lucky Boy Mine during September of this year. A.

JOPLIN, MO.—The new power plant of the Empire District Electric Company was started recently and is operating very satisfactorily. The plant is controlled by Henry L. Doherty & Company of New York.

DOWS, IOWA.—C. W. Gibson of the Straight Electric Company will ask for a franchise to operate an electric light plant here and seek a contract to light the city. If successful he will begin the construction of a plant at once. Z.

BRONSON, MICH.—At a village election held for voting on municipal electric light plant and water works, it was decided that the electric light plant should be purchased of W. H. Friedrich & Company at a cost of nearly $19,000.

COQUILLE, ORE.—F. Morse, proprietor of the Coquille Electric Company, has returned from a trip to Portland, Ore., where he purchased a complete electric lighting plant which will be in working order in this city by the first of October. A.

OAKLAND, CAL.—The application of the Central Light and Power Company to erect pole lines for the distribution of light and power has been referred to the Board of Public Works. The company desires to erect poles along a number of streets. A.

DE PERE, WIS.—The Northern Hydro-Electro Power Company recently turned on the current on its transmission line from High Fall to the Green Bay power house. The towers follow the right of way of the St. Paul Railway from Green Bay to the Falls.

BROWNTOWN, WIS.—J. C. Hood has been awarded the contract for the installation of a lighting plant in this city on a bid of $2,596.93. The contract calls for the installation of engine and generator and the pole line. A number of firms bid on the work.

JERSEY CITY, N. J.—The Indiana & Kentucky Power Company has been incorporated with a capital of $50,000 to supply electric light, heat and power. The incorporators are H. O. Coughlan, S. A. Anderson and John R. Turner, all of Jersey City.

KANE, ILL.—It is probable that this town will be lighted by electricity, taking power from the lines of the Carrollton Heat, Light and Power Company. F. M. Sinsabaugh, manager of the Carrollton Company, has already made a proposition to the city.

FAIRFAX, MINN.—At a recent meeting of the city council, the contract for installing a pole line and a street-lighting system was awarded to the Western Electric Company. The contract price is $3,100, and the work must be completed before November 1.

ODESSA, WASH.—Odessa is now supplied with current from the lines of the Washington Waterpower Company. Most of the business houses and more than fifty residences are now lighted with electricity, and many dwellings are ready for the installation of fixtures.

BARBOURVILLE, KY.—The towns of Harlan and Manchester will soon have electric lighting plants. Citizens of Harlan have formed a stock company for putting in a system. At Manchester a local stock company has already begun the installation of an electric lighting plant.

ESCONDIDO, CAL.—The Escondido Utilities Company, since being taken over by C. C. Glass, has planned to furnish power and electric light to Twin Oaks, San Marcos and San Pasqual Valleys. The citizens of this town have been asked to subscribe to the stock of the company. A.

SOUTH WHITLEY, IND.—At the special meeting of the town board the bid of the Westinghouse Electric and Manufacturing Company was accepted for a new 150-kilowatt dynamo, to be installed in the city lighting plant within ninety days. The contract price was $3,800 outside of the cost of installation.

SACRAMENTO, CAL.—The Great Western Power Company has almost completed installing its machinery in the city substation at Eighth and R streets, but the material for the local retail power service has not arrived from the eastern factories, so no definite date can be set for opening this branch. A.

RUPERT, IDAHO.—Rupert, Heyburn and Burley, all in the vicinity of the government's Minidoka irrigation project, will soon be numbered among the few small Western towns which boast of electricity for lighting purposes. The power for the lighting will be furnished from the plant at the government dam.

JERSEY CITY, N. J.—The Sheridan County Electric Company has been incorporated with a capital of $25,000 for the transmission and distribution of electricity. The incorporators are: Frederick W. Longfellow, Riverdale-on-Hudson, New York City; Alfred Gregory, Philip K. Walcott, both of Brooklyn, N. Y.

LADOGA, IND.—By a deal just consummated here Will and Harvey Goodbar come into the possession of the stock of the Ladoga Electric Light Company, owned by George and Ed Havens. The officers of the company are J. E. Lidikay, president; Will Goodbar, vice-president, and Eugene C. Ashby, secretary-treasurer.

SALINA, KAN.—The Salina Light, Power and Gas Company has been granted a charter. The new concern is capitalized at a half-million dollars and its object is to furnish artificial gas and light and power for the city of Salina. G. H. Smedley, C. E. Ruhe, C. W. McBride, A. W. Gay and R. N. Camp are the incorporators.

LAS VEGAS, N. MEX.—A franchise has been granted J. J. Laubach, Wm. Harper, W. J. Benjamin and W. B. Bunker, all of this city, to erect a power plant on the Rio de la Casa. The plant is to cost $100,000 and a diversion dam is to be built fifteen feet in height, thirty-five feet wide at the top and fifty feet wide at the bottom. A.

SHERIDAN, MONT.—A. B. Preston of St. Johns, Michigan, who recently obtained a franchise from the town of Sheridan, expects to soon commence work on the installation of an electric light plant and will have it in operation by January 1, 1911. The electricity for the plant will be generated by water power from the waters of Mill Creek.

TOPEKA, KANS.—The Topeka Edison Light, Heat and Power Company has found it necessary to enlarge the capacity of its plant. Within ninety days two 500-horsepower boilers will be installed. Work of increasing the pole line capacity is in progress. Sixteen thousand feet of copper cable is being installed in the business district of the city.

KANSAS CITY, KANS.—The commissioners of this city are in favor of a municipal electric light plant and have received a report of a local engineer on that subject. It is stated in the report that a suitable plant could be built for $350,000. Such a plant could sell electricity to private consumers at a greatly reduced rate and reduce the street lighting cost by half.

INDIANAPOLIS, IND.—As a preliminary toward preparation to bid on the contract for city street lighting and to care for increasing business, the Merchants Heat and Light Company is arranging to install a 10,000-horsepower engine at its new Washington Avenue plant. When this engine is ready for service, which will be about December 1, the company will have a total of 16,000-horsepower capacity.

WHEELING, W. VA.—An ordinance granting the Wheeling Electrical Company a fifty-year franchise to manufacture and sell electricity for commercial purposes in the city has been passed in both branches of the council. President R. E. Breed of the electrical company stated that the company would at once commence work on its $700,000 plant on the South Side.

BALTIMORE, MD.—It has been announced that the Susquehanna Water and Power Company will be prepared to deliver electric power to Baltimore and vicinity not later than November 1. The transmission line, which is to be carried on steel towers, is well under way. Current will be distributed and supplied to consumers by the Consolidated Company of Baltimore.

HILLSBORO, ILL.—The Hillsboro Electric Light and Power Company has purchased land as a site for a new power house which will quadruple in size the present central station. It is the plan of the concern, which will spend at least $50,000 upon improvements, to furnish current to all villages and towns in Montgomery County and also to install transformers for farmers. Z.

ROCHESTER, N. Y.—The Rochester Railway and Light Company has made a number of improvements in the vicinity of the Public Market at North Union Street, Railroad Street and Pennsylvania Avenue. All wooden poles have been taken down and new ornamental iron poles erected instead. The work was carried out under the direction of Thomas H. Yawger, superintendent of electric power.

ST. LOUIS, MO.—Stockholders of the Suburban Light and Power Company will hold a special meeting September 22 to vote upon a proposition to increase the capital stock from $209,000 to $750,000. It is proposed that $500,000 of the stock shall be preferred stock, the holders to be entitled to cumulative dividends of seven per sent before any dividends are declared or paid on the common stock. Z.

PINE RIVER, MINN.—Work on the dam in the river here has commenced and the crew is driving piles and excavating for the bigger work. About 300 horsepower will be developed which will be used to run a grist mill and an electric light plant for the village. C. E. Wood, of Minneapolis, is superintending the work and he states that they expect to be able to furnish power by December 1, this year.

ALAMEDA, CAL.—The municipal electric light plant has had a gain of 397 patrons during the fiscal year, making the total number of consumers 2,887. The total earnings of the plant for the fiscal year were $109,937.81, against a total cost of production at $67,789.03, leaving the net earnings of the plant $42,148.78. Included in the total cost of production is $13,414.52, allowed for interest, taxes and depreciation.

CLEVELAND, MISS.—The Cleveland Light, Ice and Fuel Company, which was recently purchased by Nott & Ward, of this place, and the Southern Coal Company, of Memphis, has been placed under the management of Mr. Farwell, of Memphis. This plant has been incorporated as the Home Light and Ice Company, and has added a storage department for its output of ice at an expense of about $1,500.

MILWAUKEE, WIS.—A permit to build an $80,000 addition to the Commerce Street power plant was recently issued to the Milwaukee Electric Railway and Light Company. The addition will cover an area of 80 by 144 feet and will be 72 feet high. The material will be of reinforced concrete and brick. The company also took out a permit for a substation at Clinton and Maple streets 40 by 57 feet in size, to cost $25,000.

PHILADELPHIA, PA.—The new system of metropolitan lighting is soon to be extended to include Frankford Avenue. This scheme calls for lights placed on regular poles with an eighteen-foot extension reaching out into the street. The lights will be placed on each side of the street 150 feet apart from Adams Avenue to Harrison Street, a distance of fifteen squares, which takes in the busiest parts of Frankford Avenue.

WILSON CREEK, WASH.—Ground has been broken for the erection of the building to house the new electric light and power plant. About a month ago C. J. Weller obtained an electric light and power franchise from the city council, and by the middle of November Wilson Creek will be lighted with electricity. Every business man in town has signified his intention to have the new lights installed in both business house and home.

QUINCY, ILL.—President A. E. Kidd of the Civic Improvement League has appointed a committee consisting of Charles Rosenheim, C. N. Ware, Julius Kespohl, George Eisele, F. H. Surlage, T. E. Thompson, W. H. Schfindler, W. H. Nelson, P. L. Dickhut, J. L. Kennedy, W. J. Henry, H. H. Harmon and himself to consider and formulate a plan to introduce the ornamental lighting system into the business district of the city. Z.

BANGOR, ME.—The Franklin Light and Power Company, of Farmington, will in a short time complete its new generating plant at North Anson, and will then be ready, after two years' work and the expenditure of $100,000, to transmit electricity for light and power. The generating plant at the Carrabasset River, sixteen miles distant, will supply Farmington. Samuel Tarbox, of

Farmington, is president of the company and S. C. Sturtevant, treasurer and general manager.

WALLHILL, NEB.—The bonds voted by the village of Wallhill have been sold to the State of Nebraska at par, realizing $22,500, which will be used in constructing a modern system of electric lights and a water works. Very extensive plans have been prepared for the distribution of light and water to all parts of the town and bids on the construction of the system. Many houses are being wired for light, and it is expected that the system will be completed this year.

MARCUS, WASH.—A party consisting of H. Allenberg, Spokane; F. L. Tate and several capitalists from Philadelphia, and Engineer Sylvester of the Kettle River Power and Light Company inspected the power site of the company recently and stated that work will probably be commenced inside of the next thirty days, and will be completed by March 1. The estimates call for the expenditure of $191,000. The company will furnish power for the mines and light and power for Marcus.

ANN ARBOR, MICH.—The Eastern Michigan Edison Company has purchased the Dover and Hudson mill dams, near the headwaters of Huron River, just below Portage Lake. The dams and two miles of bank, with flowage rights, were secured from the Birkett Manufacturing Company, a concern formerly in the milling business in Dexter Township. The deed gives the Edison Company the right to create a power reservoir over two miles long and extending to and connecting with Portage Lake.

SPOKANE, WASH.—The Pacific Exploration Company has been granted permission to erect a power plant with a daily capacity of 25,000 horsepower, on the Pend d'Oreille River near Waneta. Electric power for the Pend d'Oreille Valley, Sheep Creek and Ymir districts and the Orient, Chewiah and Metaline districts will be supplied, also the Northport smelter. N. G. Hall of Nelson, B. C., is the president of the company, J. W. Falls the manager and A. Y. Lorch the secretary. W. H. Jones, a Spokane, Wash., capitalist, is also interested in the project.

DURHAM, N. C.—While there is a strong rivalry among the towns of the Carolinas to secure the three auxiliary steam generating plants of the Southern Power Company to take care of its business in case of temporary shutting off of current, it is stated that Durham is practically agreed upon as one of the towns which will get one of these auxiliary plants of probably 10,000 horsepower. The town recently granted a sixty-year franchise to the Southern Power Company, and the above report is based on opinions attributed to W. S. Lee, Jr., general manager of the Southern Power Company. L.

SHERIDAN, WYO.—A crew of men has been sent out by the Sheridan Electric Light and Power Company to commence pole work on the new transmission line between the local plant and the mines. The line will be rushed to completion as quickly as possible, as under the terms of the contracts with the Acme and Monarch mines the power company must furnish them 600 horsepower by September 15. These contracts provide only for power during the day until the new 4,000-horsepower plant on the Big Goose and Tongue River is completed this fall, as the entire present equipment is needed at night to light the city.

WICHITA, KANS.—The Kansas Gas and Electric Company is constructing a transmission line from its power plant in this city to Valley Center for the purpose of supplying electrical power for the Arkansas Valley Interurban Railway. The cost of the installation of the poles and wires from here to Valley Center will be about $28,000, and the equipment at both ends of the line will cost about $20,000 more, making the total expenditure for the line about $50,000. Work on the construction of the power house of the Kansas Gas and Electric Company, at the junction of the Big and Little Arkansas rivers and south of Third Street, is being rushed and will probably be finished by November 1.

SAN FRANCISCO, CAL.—A. G. Wishon, manager of the San Joaquin Power Company, says the San Joaquin Power Company is planning to add about 2,000,000 pounds of wire to its valley power lines. The routes provide for some 400 miles of wire. In six months it will have current supplied to the Midway and Sunset oil fields. Lines will be built to Bakersfield, Maricopa, the Midway, and down the West Side from the new power plant in Crane Valley. Following this it will rush the power line to Merced. A full set of estimates is now being made out by E. L. Haines, electrical engineer for the San Joaquin Power Company, who is here conferring with General Manager Wishon. A.

DENVER, COL.—Sanderson & Porter of New York City have recently contracted with the Westinghouse Electric and Manufacturing Company for two 1,250-kilovolt-ampere turbo-generators to be used in the power plant of the Federal Light and Traction Company of this city. The generators are three-phase, sixty-cycle, 2,300-volt, 3,600-revolutions-per-minute machines. Two No. 8 Le Blanc condensers will be used in connection with the steam turbines. The generator fields will be excited by two fifty-kilowatt, 125-volt, direct-current turbo-generators to be used in connection with a Tirrill regulator. The order also includes the necessary transformers, lightning arresters, disconnecting switches and switchboard.

ELECTRIC RAILWAYS.

(Special Correspondence.)

AMBOY, ILL.—Work has begun at Lee Center on the construction of an electric interurban line to run from Amboy to DeKalb.

LOUISVILLE, KY.—The Shelbyville extension of the Louisville & Eastern Railway was formally opened to the public a short time ago. Cars are to run every hour.

WAYNESBORO, PA.—Surveyors have started work on laying out an extension of the trolley system of the C. G. & W. Railway Company from Penham to Blue Summit.

KANKAKEE, ILL.—The stockholders of the Kankakee & Urbana Traction Company have elected as directors: C. S. Van Doren, Urbana, and John Eden, Kankakee. Z.

MONTGOMERY, ALA.—The incorporation of the Alabama, Florida & Southern Railway to run twenty-five miles, from Marmill to Milton, Fla., has been reported to the secretary of state. The capital is $40,000, all paid in.

ARDMORE, OKLA.—The assets and holdings of the Ardmore Traction Company were sold recently at public auction. H. S. Patterson, of El Reno, and George S. Craven, of Milton, Ia., were the purchasers, the price being $50,200.

WASHINGTON, D. C.—The Capitol Traction Company has recently entered an order for twenty double equipments of Westinghouse No. 306 fifty-horsepower 500-volt railway motors, and twenty equipments of double end Type K-27 control.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company is stringing the wires for the Birmingham and Edgewood Street Railway leading into Shades Valley through Rosedale and Edgewood. Cars should be operating within a short time.

LINCOLN, NEB.—It is reported that St. Louis capital has been interested in the Lincoln-Beatrice & Hastings Interurban line and that the present Ralston line would be financed and completed shortly. It has also been stated that $1,000,000 had been promised for the completion of the line.

KANSAS CITY, MO.—A petition has been presented to the board of park commissioners, urging the extension of the street railway from its present terminus at Sixty-seventh Street and Swope Parkway to Sixty-second Street and the Parkway. The petition has been signed by over $5,000 persons.

HACKNEY, KANS.—The Southwestern Interurban Railway Company has started work on a power plant here. The plant will, when completed, furnish power for the entire line. Power is now furnished by the Arkansas City Power and Light Company, whose contract expires on February 1, 1911.

MILLVILLE, PA.—It now seems certain that the electric line between Millville and Ocean City will be constructed. A company known as the Millville, Tuckahoe and Ocean City Electric Transportation Company has been incorporated with a capitalization of $100,000. The incorporators are E. W. Rush, Hartwell Shepherd, Thomas Frome, George Haines, Tillman Rush and L. C. Wainwright.

TOLEDO, O.—A receivership is asked in a petition filed here this week by James H. Pheatt against the Toledo Interurban Construction Company, which built the Toledo, Port Clinton and Lakeside Interurban Railway. The petition alleges that the officers of the company have dissipated the bonds and stocks of the company to their own interests. The Toledo, Port Clinton and Lakeside Railway is in no way affected by the suit. H.

DAYTON, O.—The longest unfilled stretch of traction trestle in Ohio will be filled within the next few months and through cars running over the lines of the Western Ohio between this city and Toledo. The temporary trestle was built ten years ago over the Loramie River at Lockington, and not until recently were arrangements perfected to secure dirt to make the fill, which is more than half a mile long. Time tables all the way from Toledo to Cincinnati will be affected by the improvement. H.

NASHVILLE, TENN.—Interests back of a company to be known as the Tennessee Rapid Transit Company are promoting an interurban railroad to run north and south through Nashville, touching Springfield and Clarksville on the north and Lewisburg on the south. The proposed line will be about 125 miles in length. Those backing the road here are Robert L. Burch, R. M. Wilson, John M. Gray, Jr., Richard T. Wilson and Joseph Frank. It is estimated that about $3,500,000 will be necessary to construct the line as planned.

PHILADELPHIA, PA.—A feature of the opening of the Pennsylvania tunnel on August 30 was a series of trial trips made by prominent men and officers of the company. The first tour was made by directors, officers and heads of departments of the Long Island Railroad and directors and officers of the Pennsylvania Railroad. This trip covered the entire route and was the most elaborate trial trip which was made. A second section of this party was made up of public officials, prominent railroad men and prominent bankers.

KANSAS CITY, MO.—W. C. Doane, the engineer who is running the line for the proposed interurban electric railway from Kansas City to Springfield, Mo., has turned over to the company

the survey from Butler to Rockville, a distance of twenty-four miles. The proposed road will be 200 miles long. Work will begin as soon as the entire survey is completed. Men are at work now, going south from Rockville and north from Butler. The line will be built by Kansas City and St. Louis capitalists, and is in no way associated with the St. Louis-Kansas City Electric Railway.

SAN FRANCISCO, CAL.—Construction work has commenced on the Hanford and Summit Lake Railroad, an electric line that is to be eighteen miles in length, penetrating the fertile region of the King River delta. The company that is constructing the road is capitalized for $500,000, fully paid. Charles King, Hanford, is president; Ralph W. Heins, Santa Cruz, is vice-president; J. O. Hickman, Hanford, treasurer; George C. Aydelotte, Hanford, secretary; John B. Rogers, chief engineer for the Ocean Shore Railroad, general manager and chief engineer. Construction work, it is announced, will be completed in ninety days, and electric trains will be in operation within three and a half months.

PROVO, UTAH.—A franchise granting a fifty-foot right of way over roads of the county has been granted by the county commissioners. An electric line is to be built and the promoters, who are associated with Simon Bamberger in the enterprise, must make the surveys and be actually at work in six months, and the entire route must be selected within twelve months. At least twenty-five miles of the road must be completed within three years. The promoters have rights through most of the towns from Salt Lake to Payson. The men who appeared before the commission were: A. J. Evans, S. L. Chipman, W. L. Hayes, J. B. Keeler, D. R. Beebe, W. H. Brereton, Arthur N. Taylor, J. D. Dixon, H. T. Reynolds, John Jones, James Macbeth and George C. Whitmore.

COLUMBUS, O.—Columbus capitalists are back of the Ohio State Interurban and Electricity Promoting Company, located at Millersport, and which is to be incorporated with $99,000 capital stock. Secretary of State Thompson had asked for an opinion on the clause, as it included not only the construction of an interurban railway which runs from the lake to the Ohio River, but includes the right to sell heat, light, fuel and power in the cities through which it passes. The incorporation papers call for the operation of a standard gauge system of interurban railroads by divisions. The roads will run through twenty-nine counties, and take in many hundreds of miles of territory. The incorporators named in the papers are Albert E. Boone, H. A. Axline, Lawrence S. Climer, Levi Bright and Eugenia O. Boone.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

SPRINGFIELD, TENN.—The properties of the Home Telephone Company have been sold for $9,250, at public auction, to E. H. Cody, of Toledo, O., representing bondholders of the company.

BELOIT, WIS.—The Beloit Home Telephone Company is being reorganized, the stock that has been held in Beloit heretofore going to the Bell company. The company plans to put in a new building and an entire new central system within a short time.

TEMPLE, TEX.—Efforts are being made to interest local business men in a plan to build a long distance telephone line to parallel the Temple-Northwestern Railway, the movement being headed by D. C. McGowan of Belton, associated with D. R. Walton. The movement would open up about one hundred miles of territory to local citizens.

SPARTA, TENN.—Sparta is to have a second telephone exchange as soon as it can be installed. The Home Telephone Company of White County has perfected its organization and secured a franchise. A crew has started work erecting poles and stringing wires. The officers are Sam Johnson, president; C. W. Roberts, vice-president; J. L. Jarvis, secretary and treasurer.

NORFOLK, VA.—The new $75,000 telephone switchboard, capable of handling the combined service of the Southern Bell and the Southern States Telephone Companies, has arrived in Norfolk, and is now being installed in the Southern Bell's exchange building. It will be the middle of October before the transfer of the Southern States' wires to the Bell's switchboard is completed.

SAN ANTONIO, TEX.—It is announced by the Southwestern Telegraph and Telephone Company that by January 1 long-distance telephone connection via that line will be established between San Antonio and Brownsville. A copper wire circuit is being built between Brownsville and Corpus Christi and when this is completed direct connection will be made with San Antonio.

NORWICH, CONN.—There is now being completed by the Southern New England Telephone Company an absolutely direct, or what might be termed an air line route for toll wires connecting New Haven on one end with Willimantic and Norwich on the other. The route is by way of Durham, Higganum, Westchester and Colchester, which is the shortest possible toll route for this purpose.

DECATUR, ALA.—There is a movement on foot here toward the purchase of the Morgan County Telephone Company, an independent company of the Decaturs, by the Southern Bell Telephone Company. The Southern Bell is asking for a renewal of its franchise in New Decatur. It is said also that the Southern Bell is figuring on building a telephone building here to cost about $20,000, in the event they buy the Morgan County Company and get a new franchise in New Decatur.

WHEELING, W. VA.—It is stated that about $25,000 will be expended within a short time by the Bell Telephone Company in remodeling and re-arranging the company's building in this city. Approximately $10,000 will be expended in extending the entire top floor to the alley in the rear, thus giving accommodations for the district as well as the local offices of the Bell system. Another $15,000 will go towards the installation of a new toll board, while additional repairs will be made to the interior.

AUSTIN, TEX.—A meeting of representatives from a large number of independent telephone companies in this territory was held on August 30, for the purpose of getting the telephone companies in closer touch with one another and improving the service. The United Telephone Company, of this city, which has connection with most of the surrounding rural exchanges, serving about 700 farm patrons, was chiefly instrumental in calling the meeting. Two sessions of two hours each were held, and it was decided to hold similar meetings every three or four months, in order to keep in close touch with the work and improvements being carried on by the exchanges.

GRAND RAPIDS, MICH.—The Michigan State Telephone Company will close the season with a total expenditure of about $95,000 for improvement in this city. Much of the work has already been accomplished, but it will be a couple of months before everything is done. The switchboard capacity of the main exchange has been increased to 5,500 and a new charging plant has been put in. The South-End exchange has been increased to a switchboard capacity of 1,700. A new exchange has been built at Greenville, to be known as Grand, with 350 subscribers, and through this exchange connections will be made for all that territory west of the south exchange, in Wyoming, Gaines and Georgetown. New rural lines are being built to Berlin to accommodate about 150 subscribers. The company already has an exchange at Dutton. In addition to this construction and extension work the company has laid about two miles of conduits in the down town streets, representing a duct length of about thirty miles. This has been one of the most active years for construction and improvement in the history of the company in this city.

ELECTRICAL SECURITIES.

The dullest August in the past ten years was closed by a correspondingly dull week, as there was a tendency to reduce commitments over the three days' holiday. Total sales for the month were 10,000,000 shares, comparing with 24,000,000 of a year ago. Bond sales were $31,000,000, comparing with $113,000,000 for last August. Total sales for the week were 1,389,900 shares, an average of 277,980 a day, whereas the totals for the corresponding week in the three years preceding were, respectively, 3,133,650, 3,040,450 and 3,537,964 shares. Of the total transactions the three mainstays of the professionals—Reading, Steel and Union Pacific—furnished more than sixty-five per cent, indicating the character of the trading. July statements of big roads indicate to what extent increased expenses, by way of advances in wages and greater cost of materials, are encroaching upon earnings.

August gross earnings of the Massachusetts Electric Companies showed an increase of $20,000, or two per cent, compared with an increase of $71,200, or 8.1 per cent, in July, and a decrease of $12,000, or two per cent, in June.

Proxies have been sent out for the annual meeting of the Philadelphia Rapid Transit Company, September 21, in the names of Charles O. Kruger, Clarence Wolf, J. J. Sullivan and W. H. Shelmerde.

The daily traffic of the Northwestern Elevated for August was 119,605 passengers, an increase of 14,815, or 14.14 per cent. Gross earnings for the Northwestern Elevated in the year ended July 31, 1910, will show an increase of $250,000 over 1909. There were 42,865,000 passengers carried, against 40,995,785 last year.

The annual meeting of the Tri-City Railway and Light Company will be held at Hartford, Conn., on September 15. Stockholders will be asked to act upon the authorization of $20,000,000 first and refunding mortgage five-per-cent bonds and the execution and delivery by the company of a mortgage upon its property and franchises and upon the property and franchises of subsidiary companies for the purpose of securing the above-mentioned bond issue.

August was a particularly good month for the Boston Elevated, considering that the weather was cooler than a year ago. Increases in gross earnings was 5 per cent, compared with a 6.4 per cent increase in July, which was the best gain for any month since November. In June the increase was a mere fraction of one per cent, while the increase in May was four and a half per cent. The company will shortly place orders for between $1,200,000 and $1,400,000 additional rolling stock to take care of its steady increase in business. The order will include 100 surface cars and between thirty and forty "elevated" cars.

DIVIDENDS.

Manhattan Railway; regular quarterly dividend of one and three-fourths per cent, payable October 1 to stock of record September 15.

Muskogee Gas and Electric Company, of Muskogee, Okla.; regular quarterly dividend of one and three-fourths per cent on the preferred stock, payable September 15 to holders of record August 21.

Oklahoma Gas and Electric Company of Oklahoma City; regular quarterly dividend of two per cent on its common stock, payable September 15 to stock of record August 31. This is an increase of one-half of one per cent.

San Diego Consolidated Gas and Electric Company of San Diego, Cal.; regular quarterly dividend of one and three-fourths per cent on its common stock, payable September 15 to holders of record August 31. This is an increase of one-half of one per cent.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Sept. 5.	Aug. 29.
Allis-Chalmers common	8	8½
Allis-Chalmers preferred	31	31½
Amalgamated Copper	63½	64½
American Tel. & Cable	*80	*80
American Tel. & Tel.	134¾	133¾
Brooklyn Rapid Transit	74⅝	74
General Electric (ex dividend)	141¼	142¼
Interborough-Metropolitan common	18⅝	17½
Interborough-Metropolitan preferred	49⅝	47⅞
Kings County Electric	121	120
Mackay Companies (Postal Telegraph and Cables) common.	85	85
Mackay Companies (Postal Telegraph and Cables) preferred.	74½	73¾
Manhattan Elevated	129	130
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
U. S. Steel common	68¾	69¼
U. S. Steel preferred	116	115⅞
Western Union	61	61
Westinghouse common	57	58
Westinghouse preferred	*125	*125

*Price at last quotation.

BOSTON.

	Sept. 5.	Aug. 29.
American Tel. & Tel.	134¾	133¾
Edison Elec. Illuminating	258	258
General Electric (ex dividend)	141¼	142½
Massachusetts Electric common	17½	17
Massachusetts Electric preferred	80	80
New England Telephone	129	129
Western Tel. & Tel. common	14½	15
Western Tel. & Tel. preferred	83	83

PHILADELPHIA.

	Sept. 5.	Aug. 29.
American Railways	44	44
Electric Company of America	11⅞	11¼
Electric Storage Battery common	46¾	47½
Electric Storage Battery preferred	46¾	47½
Philadelphia Electric	15	15
Philadelphia Rapid Transit	17¼	17¾
Philadelphia Traction	83¾	83
Union Traction	42½	43½

CHICAGO.

	Sept. 5.	Aug. 29.
Chicago Railways, Series 1	70	70
Chicago Railways, Series 2	16	15¾
Chicago Subway	4½	4⅝
Chicago Telephone	117½	117¼
Commonwealth Edison	110	111
Metropolitan Elevated common	19	
Metropolitan Elevated preferred	60	59
National Carbon common	118	118
National Carbon preferred	118¼	118

PERSONAL MENTION.

S. MAYS BALL has moved his shop from Warm Springs to Atlanta, Ga., where his address will be 205 Peachtree Street.

E. T. ADAMS, head of the gas engine department of the Allis-Chalmers Company, recently resigned his position with that company.

A. MURRAY COOMBS, of London, England, has been appointed inspector for supplies in England for the South Indian and G. I. P. Railways.

L. J. WHITE has taken charge of the plant of the Dallas Electric Light and Power Company at Dallas, Tex., as general manager. The plant was recently purchased by H. M. Byllesby & Company of Chicago.

F. E. FISHER has resigned as general manager of the Joliet & Southern lines to take up the construction work of the Morris-Joliet line of the McKinley system. He assumed charge September 1 with headquarters at Joliet.

J. P. ALEXANDER, purchasing agent of the Wheeling Traction Company, Wheeling, W. Va., for the past five years, has resigned to take a position in electrical engineering work with the General Electric Company at Pittsfield, Mass.

H. M. BYLLESBY and his business organization are the subjects of a sketch in a recent issue of the *Bankers' Magazine*, entitled "Engineering and Commercial Skill Applied to the Operation and Management of Public Service Corporations."

WILLIAM A. HANNA, president of the Saugerties Electric Light and Power Company, Saugerties, N. Y., died in the Kingston city hospital recently from a cerebral hemorrhage. Mr. Hanna was taken suddenly ill while in attendance at court.

E. A. NASH, of London, England, was recently appointed secretary and business manager of the Electrical Standardizing, Testing and Training Institution, by the Governors of Faraday House. Mr. Nash takes the place of Howard Foulds, who has been appointed secretary to the Electricity Department of Birmingham.

ROBERT MATHER, chairman of the board of directors of the Westinghouse Electric and Manufacturing Company, is convalescing from injuries received in an automobile accident. While riding with friends Mr. Mather was, by a sudden jolt, thrown against the cover of the car, cutting his head and injuring his back.

DUNCAN McDONALD, of New York, sailed recently on the *Mauretania* to exhibit the pay-as-you-enter cars in London, Paris and Brussels. While at Brussels he will be the guest of the European Tramway Congress and on his arrival there he will ride about the city in a pay-as-you-enter car which was shipped to Belgium some time ago. Mr. McDonald said he expected that Paris would be the first city to take up this sort of trolley car and that the other important municipalities most likely would follow.

A. BEMENT, of Chicago, the well-known consulting engineer, was married to Miss Eva Henderson at Berkeley, Cal., on August 23. As a feature of their wedding trip Mr. and Mrs. Bement took a coach ride to the summit of Mount Tamalpais. Before reaching the summit, however, the horses suddenly shied and on running away nearly dragged the carriage over the edge of a ravine 500 feet deep. Both the occupants of the vehicle were thrown out of its window and suffered numerous painful bruises, but fortunately were not dangerously injured.

EDWARD B. ROGERS, of Elmira, a telephone man of twenty-two years' experience, has been appointed Chief of the Division of Telephones and Telegraphs of the New York Public Service Commission, Second District. Mr. Rogers commenced service as a clerk for the New York and Pennsylvania Telephone and Telegraph Company and for six years prior to its absorption by the New York Telephone Company was general manager of that corporation. At the time of his appointment by the commission he was special agent for the New York Telephone Company.

M. S. SEELMAN, JR., the new editor of the National Electric Light Association Question Box, has been associated with the Edison Electric Illuminating Company, of Brooklyn, for the past nine years, during which period the business of that company has been multiplied by six. Mr. Seelman has had charge of the advertising and some other commercial activities of the company, and his work has given him a national reputation in the industry. In 1906, Mr. Seelman was the winner of the first prize of $500 in a competition for the best paper on the "Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population or Under." This prize was offered by the Co-operative Electrical Development Association, and was awarded at the 1906 convention of the National Electric Light Association at Atlantic City. Mr. Seelman has presented a number of papers before the National Electric Light Association, and the Association of Edison Illuminating Companies, and has taken part in many discussions. Prior to his connection with the electric lighting industry, Mr. Seelman had been in newspaper work for a number of years. He has taken up his new work with great zeal and energy and his first contributions will appear in the September "Box."

OBITUARY.

ISAAC W. HALLAM, one of the oldest telegraphers in the service, died recently in Wilmington, Del., at the age of 81. He was employed by the Western Union Telegraph Company for fifty-two years.

CHARLES TALBOT PORTER, an engineer and inventor of international reputation, died at his home in Montclair, N. J., after a brief illness. In recognition of his work in advancing steam engineering and for improvements in engine construction Mr. Porter received the John Fritz medal in 1909, the medal being conferred by joint action of the four national engineering societies. Mr. Porter was a graduate of Hamilton College and originally practiced law, but retired from that field after handling a case involving a patent.

NEW INCORPORATIONS.

PHILADELPHIA, PA.—The P-T Electrical Supply Company has incorporated under the laws of Delaware with a capital of $100,000. The incorporators are: W. H. Price, Moore, Pa.; W. H. Tatem and U. E. Crane of Philadelphia.

ALBANY, N. Y.—The Moxomite Insulating Company has been incorporated to manufacture and apply insulating material of all kinds to copper wire, tubes, etc. The capital of the company is $10,000 and its incorporators are Wm. E. Milbank, Myron D. Shiverick, and Frederick A. Tyler, all of Albany.

NEW YORK, N. Y.—The Northwestern Electric Equipment Company has incorporated and will do electrical work of all kinds. Engineering work will also be done and motors and generators sold. The company has a capital of $10,000 and was incorporated

by Chas. I. Taylor, Frank H. Parcells and Robert G. Rediefsen, all of New York.

NEW YORK, N. Y.—The Electrical Vehicle Association of America, with principal offices in New York City, has been incorporated with the Secretary of State. Among the directors are William H. Blood, Jr., and Frank J. Stone, of Boston; Hayden Eames, of South Bend, Ind.; Charles Blisard, of Philadelphia; Herbert H. Rice, of Indianapolis; W. W. Freeman, of Brooklyn; Frank J. Gyer, of Orange, N. J., and Arthur Williams, Harry C. Cushing, Jr., and Harvey Robison, of New York City.

NEW PUBLICATIONS.

THE EDISON ROUND TABLE.—In the midsummer number of this publication is included an account of the lighting of a large outdoor arena, which was used for military drill. Several other articles with illustrations make the number one of considerable interest.

WEBSTER'S NEW INTERNATIONAL DICTIONARY.—The publishers (G. & C. Merriam Company, Springfield, Mass.) of Webster's New International Dictionary which was reviewed at length in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, December 4, 1909, p. 1098, has issued some instructive literature relating to this greatest one-volume dictionary ever published. One brochure tells of "The Origin, the Making and the Character of Webster's New International Dictionary," while another is entitled "A Necessity to Success." In the latter it is noted: "It is a delusion to consider the New International as merely an enlargement and correction of the old International. It is rather a rebuilding of the old on a larger and more imposing scale. The reconstruction is radical, a very large percentage of the material being new matter." For our part we can only reiterate our former assertions, and emphasize the fact that no one who reads and writes English can afford to be without this universal key and record of the earliest and latest developments and progress of English language and literature, and the arts and sciences.

INDUSTRIAL ITEMS.

THE AMERICAN CONDUIT COMPANY, East Chicago, Ind., recently mailed postal cards calling attention to its bituminized fiber conduit. A diagram is used to show an installation of the conduit.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, O., has issued a pamphlet containing facts about lifting magnets. The apparatus is thoroughly discussed and a number of diagrams and illustrations are included.

THE H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., continues its article on "The Roof of the World" in the August issue of the *J.-M. Roofing Salesman*. An interesting comparison is made in this number between slag roofing and J.-M. roofing.

MAC GOVERN ARCHER & COMPANY, New York, N. Y., advertise for sale in their September stock list a full line of electrical and steam machinery as well as cars and equipment. The company is at all times in the market for electrical and steam machinery.

THE R. THOMAS & SONS COMPANY announces the opening of an office at 1255 Old Colony Building, Chicago, Ill., where all inquiries and orders will be given close attention. The office is in charge of R. W. Harms, who has been with the company at New York for over five years.

THE BRYAN-MARSH COMPANY recently sold to the Denver Gas and Electric Company 12,000 Bryan-Marsh Mazda sign lamps, to be used for decorating the new building which the company will occupy this fall. This new sign will be the largest display of Mazda sign lamps shown in this country.

THE GREGORY ELECTRIC COMPANY, of Chicago, is conducting a special sale of Thomson watthour meters for both direct and alternating current, as they have secured a large lot of these at a bargain. Sizes from three to one hundred amperes are available at very low prices, and mail orders are invited for immediate delivery.

THE GOLDSCHMIDT THERMIT COMPANY, New York, N. Y., recently issued a folder on Thermit butt-welded pipe joints. An illustration is given showing a cross section of Thermit butt-welded joint made in a four-inch double-extra-heavy pipe. The apparatus with which these welds are made is portable and can be carried easily by one man.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., lists in the September number of *Trumbull Cheer* a line of tungsten rosettes with shock absorbers. These rosettes are provided with a laminated cotton felt cushion which takes the support off the lamp and eliminates the vibration from the tungsten filament.

THE BEARDSLEE CHANDELIER MANUFACTURING COMPANY, Chicago, Ill., shows in Catalog No. 20, a large variety of lighting fixtures, designed especially for tungsten and inverted gas lamps. The low prices, new designs and the original Beardslee system of pricing fixtures are all of interest to both the old customer and the prospective buyer.

THE SPRAGUE ELECTRIC COMPANY, New York, N. Y., has published Bulletin 235 on the subject of direct and alternating current disc and propeller fan outfits, and Bulletin 234 on portable electric drills. The bulletin dealing with fans is well illustrated and contains tables covering Blackman & Davidson direct-current outfits and Dawson alternating-current outfits.

THE HOLOPHONE COMPANY, Newark, O., in its August number of *Holophone Illumination* describes the lighting of the store of A. T. Namm & Son in Brooklyn. This is a large department store and gives excellent opportunities for the Holophone reflectors, which are used with Mazda lamps. The issue contains other descriptive articles and numerous illustrations.

THE EDGE MOOR IRON COMPANY, Edge Moor, Del., includes in its catalog of boilers, not only diagrams and engravings of the boilers, but illustrations of the shops and of various stages of manufacture. The company's principal product is boilers of the water-tube type in three styles—standard, with superheating outlets and with superheaters. They are all fully described in the catalog mentioned.

THE HERRICK ENGINE COMPANY has announced the invention of its rotary engine. Hitherto none of the rotary engines invented have been successfully operated for any reasonable length of time. In this case an important new principle has been discovered, that of balancing unequal lateral thrusts on the rotor shaft of any rotary engine having but a single blade. Some other defects have also been overcome.

THE ROCHESTER ELECTRIC MOTOR COMPANY recently mailed to the trade a booklet entitled "Why Use Rochester Motors?" Direct-current motors are made by this company in the following types: Constant-speed, both shunt and compound-wound; varying speed, both series and compound-wound; adjustable speed, shunt-wound. These are described and illustrated in the booklet. An announcement is made in this publication that the company's engineers are at all times at their customers' service to assist them in the selection of suitable motors.

THE KELLER MANUFACTURING COMPANY, Philadelphia, Pa., is conducting an advertising campaign through the Public Service Electric Company, of New Jersey, which supplies electric light service to sixteen of the principal cities in that state. In each town the patrons have been invited to witness demonstrations of the Keller-Santo vacuum cleaners at the lighting company's office. The Keller Company calls the attention of central stations to the good profits which can be realized on the machines sold, and to the income which results from their use.

THE GENERAL VEHICLE COMPANY, Long Island City, N. Y., recently mailed its September number of *Elec-Tricks*, containing a number of items of interest. Among others an article regarding the factors that influence the purchase of motor wagons is reproduced from the *Power Wagon*. As a supplement to the publication an engraving of the equipment of the Independent Messenger Company of Rochester, N. Y., is inserted. This is a rather striking example of the growth of business that has resulted from the use of the General Vehicle Company's equipment.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., announces in a circular letter that it is making an extensive campaign for the education of present and prospective users of electricity. The chief object of the campaign is to show these users just why lighting bills increase in the fall and that this rise is due to purely natural reasons. A folder which accompanies the letter shows a full page advertisement, which will appear in the *Saturday Evening Post* and other publications. Throughout the advertising matter the company makes use of its "Bill Raisers" idea.

THE NATIONAL ELECTRIC SPECIALTIES COMPANY, 20 Broad Street, New York, N. Y., is distributing a folder setting forth the merits of the "Slipon" improved lamp cord adjuster. This device is adapted to modern methods of installing drop lights. It is made of porcelain throughout and is, therefore, fireproof. Simplicity, adaptability and handiness are distinctive features of the Slipon adjuster, which it is said can be installed in a few seconds without the use of tools, removal of socket or cutting of cord. It is also said that this adjuster will not chafe the isulation of the lamp cord.

THE CARBOLINEUM WOOD PRESERVING COMPANY, Milwaukee, Wis., is mailing a booklet which is of interest to the users of poles and cross-arms. Several letters indicating the satisfaction with which the carbolineum has met are reproduced, and an order from the government for Avenarius Carbolineum is also reprinted. An interesting feature of the booklet is the reproduction of a photograph showing some treated telephone poles compared with those not treated. The treated poles after nine years' use show no decay at all while the bases of those untreated are nearly rotted away.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., has been awarded a contract by the United States Government for one-half of the Government's requirements of incandescent lamps for the fiscal year ending June 30, 1911. The requirements of the Government cover the Navy Department, Treasury Department, War Department, Isthmian Canal Commission and other departments, and amount to $200,000 or more per annum, or the equivalent of about a million and a half lamps. The general Electric Company was awarded the contract for the other half of this business.

JULIUS ANDRAE & SONS COMPANY, Milwaukee, Wis., recently issued an attractively prepared semi-centennial souvenir booklet in which is contained a history of the development of the

company. The building in which the business was started is shown by an illustration, and for purposes of comparison a later building and the present building are also included. Several parts of the office, stock-rooms, and shops give an excellent idea of the large amount of business done by the concern. Portraits of a number of officers and men in the offices and shops appear in connection with the descriptive matter.

THE FEDERAL ELECTRIC COMPANY, Chicago, Ill., mentions in the September number of *The Federalist* the lighting of the Lincoln Park Casino. The illumination of this building, with the exception of the main hall, is provided by Federal No. 782 clusters with porcelain enameled-steel shades. This number also makes mention of the No. 306 socket and metal shade and the No. 784 and 785 street hoods. These latter are new this month and are an arrangement that has been much sought after. It is a serviceable street hood that is supported from three points and can not tip or turn over in the wind. Illustrations of the socket, shade and hoods are shown.

THE DE LAVAL STEAM TURBINE COMPANY, Trenton, N. J., recently issued a bulletin on the De Laval centrifugal pumps. A part of the booklet is devoted to the characteristics of centrifugal pumps and curves are given showing the head developed by the pump at different deliveries, the power required to drive the pump at different deliveries and the mechanical efficiency developed throughout the range of output or capacity of the pump. The method of obtaining these curves is also described. The major part of the bulletin is given to a description of the construction of the pumps and a number of excellent half-tone illustrations are used in connection with the text.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., impresses on central stations, through a recent booklet, the opportunity for power sales to the users of automobiles. With a view to the education of the public in the use of electric vehicles, an advertising campaign has been started and the opening advertisements are shown in the booklet. The advertisements will be reproduced in the *Saturday Evening Post* and are prepared with the idea of creating confidence, first in the electric motor, and consequently in the electric vehicle. A booklet will shortly be issued by the same company in the interest of a larger use of the electric pleasure vehicle. They will be given to central-station companies and issued for general distribution.

THE METROPOLITAN SWITCHBOARD COMPANY, New York, N. Y., has distributed a very ingeniously prepared folder showing how the plug mechanism is removed from the Metropolitan detachable-mechanism switch. The cover of this folder, which is imprinted with a half-tone engraving of the switch, is so arranged as to be opened by following the printed directions to "pull out the plug mechanism." The tongue which fastens the folder together is a reproduction of the plug mechanism. Metropolitan detachable switches are made in two parts—the porcelain box and the detachable switch-mechanism. With this arrangement the box can be installed while the building is being built and the mechanism may then be put in at some later time. The company has also mailed a booklet listing detachable flush-switches and receptacles.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., recently issued a number of bulletins pertaining to apparatus and machinery which it has placed on the market. Bulletin No. 4746 describes a portable substation built to supply intermittent power for electric roads, and to provide for a temporary supply of power in case of accidents at substations equipped with only one rotary-converter unit. This station consists of a specially arranged car containing a complete substation equipment and may be conveniently moved to any section of the line that temporarily requires power. In Bulletin No. 4754 are described in considerable detail the company's continuous-current and alternating-current motors for use in steel mills, and similar places, in connection with cranes, hoists, and other apparatus. The Thomson polyphase watthour meters which are made for the specific purpose of measuring energy in any two-phase, three-phase, or monocyclic circuit, are described in Bulletin No. 4762. These meters may be applied to a circuit carrying a mixed load of lamps, motors or other translating devices, and will record accurately, irrespective of unbalanced load conditions. Bulletin No. 4764 illustrates and describes a line of Mazda compensators and low-volt lamps. Compensator lamps may be used to advantage where small units of light are employed, or in connection with gasoline-engine-driven generating sets, and particularly where the lamps are frequently moved about and subjected to jars. They are also used in connection with ornamental street lighting, and when so used are operated on the standard multiple circuit in connection with a compensator which is installed in the base of the pole. The bulletin contains data relative to the cost of operating these lamps and shows a diagram of connections. The low-volt lamps are designed for operation on voltages of twenty volts and below, and are usually employed for battery service or in series. Bulletin No. 4761 deals with the Sprague General Electric Type-M control. It supersedes all the company's publications on this subject and should be of interest to all electric-railroad men. Bulletin No. 4758 is devoted to Mazda sign lamps and contains a statement of the characteristics of these lamps, wiring diagrams showing the method of changing regular multiple sign wiring to series for Mazda sign lamps, and other wiring methods used with these lamps.

DATES AHEAD.

New England Section, National Electric Light Association. Fall convention, Eastern Point, New London, Conn., September 13 and 14.

International Congress of Radiology and Electricity. Brussels, Belgium, September 13, 14, 15.

Pennsylvania Electric Association. Convention, Glen Summit Springs, Pa., September 14-16.

National Association of Cotton Manufacturers. Semi-annual meeting, Portsmouth, N. H., September 15, 16, 17.

Pacific Coast Electrical Exposition. San Francisco, Cal., September 17-24.

American Mining Congress. Thirteenth annual session, Los Angeles, Cal., September 26 to October 1.

Colorado Electric Light, Power and Railway Association. Next convention, Glenwood Springs, Colo., September 21, 22 and 23.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Kansas City, Kan., September 27 and 28.

Vermont Electrical Association. Annual meeting, Brandon, Vt., September 28 and 29.

Denver Electric Show. Colorado Electric Club, Denver, Colo., October 8-15.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 10-14.

American Society of Municipal Improvements. Annual convention, Erie, Pa., October 11-14.

Western Association of Electrical Inspectors. Sixth annual meeting, Omaha, Neb., October 11, 12 and 13.

Railway Signal Association. Annual meeting, Richmond, Va., October 12-15.

American Electrochemical Society. Eighteenth general meeting, Chicago, Ill., October 13-15.

Order of the Rejuvenated Sons of Jove. Eighth annual meeting, Birmingham, Ala., October 13-15.

American Iron and Steel Institute. First meeting, New York City, October 14 and 15.

Illuminating Engineering Society. Annual convention, Baltimore, Md., October 24-25.

American Association of Electric Motor Manufacturers. Semi-annual meeting, Chicago, November 14-16.

Alabama Light and Traction Association. Next meeting, Anniston, Ala., November 21-23.

Directory of Electrical and Allied Engineering and Scientific Societies

(Published in the second issue of each month.)

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NATIONAL ASSOCIATION OF COTTON MANUFACTURERS. Secretary, C. J. H. Woodbury, Boston, Mass.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, N. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny Street, Hartford, Conn.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, T. C. Martin, 33 West Thirty-ninth Street, New York, N. Y.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ware, Monadnock Block, Chicago, Ill.
NEBRASKA ASSOCIATION OF INDEPENDENT TELEPHONE COMPANIES. Secretary, Charles H. Hood, Lincoln, Neb.
NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.
NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Alton F. Tupper, 84 State Street, Boston, Mass.
NEW ENGLAND SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, L. D. Gibbs, 39 Boylston Street, Boston, Mass.
NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass.
NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.
NEW YORK RAILROAD CLUB. Secretary, H. D. Vote, 95 Liberty Street, New York, N. Y.
NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.
NORTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary and treasurer, L. C. Lane, Kensal, N. D.
NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.
OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O.
OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, O.
OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. E. Sanborn, Ohio State University, Columbus, O.
OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.
OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Sherrer, 195 Broadway, New York, N. Y.
ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, Roy M. Van Vliet, Monadnock Block, Chicago, Ill.
PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION. Secretary, A. H. Halloran, 901 Atlas Building, San Francisco, Cal.
PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, Van Dusen Rickert, Pottsville, Pa.
PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.
PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo.
PITTSBURG ELECTRIC BOOSTERS' CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Avenue, Pittsburg, Pa.
RAILWAY ELECTRIC SUPPLY MANUFACTURERS' ASSOCIATION. Secretary, J. Scribner, General Electric Company, Chicago, Ill.
RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa.
SOCIETY OF THE UNITED STATES MILITARY TELEGRAPH CORPS. Secretary, David H. Bates, 658 Broadway, New York, N. Y.
SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.
SOCIETY OF AUTOMOBILE ENGINEERS. Secretary, Alexander Churchward, 30 Church Street, New York, N. Y.
SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, Box 63, Brant Park, Mass.
SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.
SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, W. B. Head, Stephensville, Tex.
STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.
TELEPHONE SOCIETY OF NEW YORK. Secretary, T. H. Lawrence, Eighteenth Street and Irving Place, New York, N. Y.
TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Leon Spencer, Gainesville, Tex.
UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk Street, Boston, Mass.
VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsbury, Vt.
VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.
WASHINGTON SOCIETY OF ENGINEERS. John C. Hoyt, 1314 F Street, Washington, D. C.
WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe Street, Chicago, Ill.
WESTERN SOCIETY OF ENGINEERS. Secretary, J. H. Warder, Monadnock Block, Chicago, Ill.
WISCONSIN ELECTRICAL ASSOCIATION. Secretary, John S. Allen, Lake Geneva, Wis.
WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.
WISCONSIN STATE TELEPHONE ASSOCIATION. Secretary, Paul J. Weirich, Monroe, Wis.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) August 30, 1910.

968,520. ELECTRIC-SWITCH-OPERATING MEANS. Albert Whion Bailey, Spokane, Wash. Filed August 30, 1909. A snap switch is operated by a yieldable star tread through a cord, a spring-retracted lever, etc.

968,524. MACHINE FOR MAKING THE JOINT BETWEEN THE FILAMENT-SUPPORT AND THE LAMP-BULB IN INCANDESCENT ELECTRIC LAMPS. Jean Barrollier, Coubevoie, France. Filed April 26, 1910. The machine includes a swiveled frame for holding the lamp bulb, a trunnioned socket receiving and forming a bearing for the frame, provided with compressed air ducts, and a tubular stem for supporting the filament support provided with holes adapted to coincide with the ducts in the socket, whereby in case of the excess portion of glass adhering by accident to the tubular stem, after the joint has been made, compressed air can be admitted through the socket and tubular stem to force the excess portion away.

968,539. MEANS FOR REPRODUCING SOUNDS FROM SOUND-RECORDS. Charles L. Chisholm, Marysville, New Brunswick, Canada. Filed February 13, 1909. Means for reproducing sound from sound records comprise a microphonic unit having a diaphragm with a fundamental higher than the rate of vibration of the normal human voice, a stylus carrier in contact with but unconnected to the center of the diaphragm of the microphone, and a telephonic reproducer in electrical connection with the microphone.

968,579. AUTOMATIC SYNCHRONIZER. Paul MacGahan, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed July 26, 1906. In combination with an alternating-current circuit, an alternating-current generator, and means for connecting the generator to the circuit, are means for insuring operation of this connecting means when the currents in the generator agree in phase with those in the circuit, said means comprising two solenoids, each having two windings, those of one solenoid being arranged to act in opposition and those of the other to act in conjunction when the currents in the windings agree in phase.

968,587. SYSTEM OF POTENTIAL REGULATION. William M. McConahey, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed Jan. 10, 1908. In combination with a transformer having a plurality of intermediate taps, and an induction regulator associated with the transformer, is an electroresponsive device for rendering the control of the transformer dependent upon the position of the induction regulator.

968,594. ELECTRICAL APPARATUS. Haakon T. Olsen, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed Jan. 10, 1908. An interlocking device comprises a pair of oppositely disposed ratchet members, engaging pawls therefor, springs for holding the pawls in engagement with the ratchet members, magnets for withdrawing the pawls, and means for making and breaking the circuits of the magnets.

968,603. MEANS FOR REGULATING ELECTRODES IN ELECTRIC FURNACES. James Henry Reid, Newark, N. J. Filed Jan. 13, 1910. The apparatus includes an adjustable electrode, a power-driven shaft, an armature geared thereto adapted when rotated to move the electrode in and out, rotatable members at opposite ends of the armature carrying electromagnets adapted to attract and hold the same, gearing connecting the rotatable members with the power-driven shaft in such a way that when one magnet is energized it will drive the armature in the reverse direction to that in which it would be driven if the other electromagnet were energized, and means for controlling the electromagnets by the current passing through the electrodes.

968,612. SPARK-PLUG. Daniel M. Tuttle, Canastota, N. Y. Filed Dec. 6, 1907. A spark plug comprises two spark terminals insulated from each other and held a fixed distance apart forming an intervening air gap, a support extending across the air gap

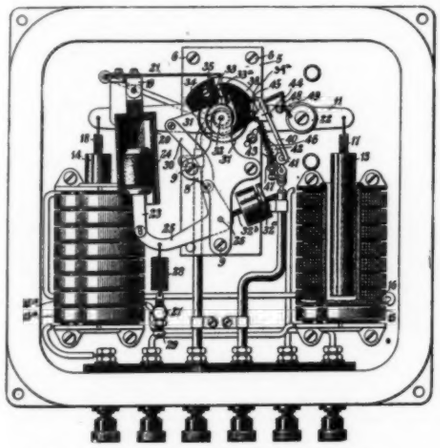
and spaced apart from both terminals, and an electric conductor encircling this support in line with and rotatable relatively to the terminals.

968,622. ELECTROPLATING-TANK. Edwin R. Williams, Streator, Ill., assignor to The Streator Metal Stamping Co., Streator, Ill. Filed Feb. 23, 1910. Includes vertically adjustable rack bars, etc.

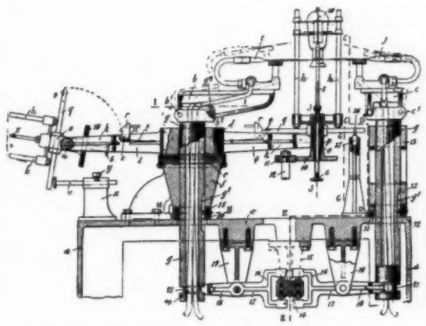
968,631. ELECTRIC MOTOR-METER. Arthur Zipplies, Mosbach, Germany, assignor to Aktiengesellschaft Korting's Elektricitatswerke, Berlin, Germany. Filed June 28, 1909. The meter includes a magnet, an armature to rotate within the field of the same, a shaft to support the armature, means to move the shaft longitudinally, a frustoconical collector carried by the shaft, and brushes having their outer ends rigidly supported and their inner ends disposed to engage the collector, whereby the pressure of the brushes upon the collector is increased when the shaft is moved longitudinally.

968,646. ANNUNCIATOR. William W. Dean, Elyria, Ohio, assignor to The Dean Electric Company, Elyria, Ohio. Filed July 26, 1909. An electric switch is controlled by a slidingly guided armature (carrying a signal) of an electromagnet.

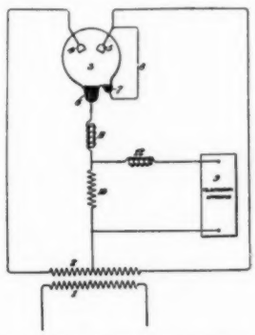
968,651. PROCESS OF EXTRACTING METALS FROM THEIR ORES. William E. Greenawalt, Denver, Colo. Filed Dec. 10, 1907. A process of extracting copper from its ores consists in treating the ore with an acid chlorid solution to dissolve the copper; passing the chlorid solution containing the copper through the cathode compartment of an electrolytic cell to deposit the copper; applying sulphur dioxid to the solution after issuing from the cathode compartment; passing the solution through the anode compartment; returning the solution to the ore, and repeating the cycle as before, until the copper in the ore is sufficiently extracted.



968,579.—AUTOMATIC SYNCHRONIZER.



968,524.—FILAMENT-JOINTING MACHINE.



968,895.—STEADYING DEVICE FOR RECTIFIED CURRENTS.

968,652. PROCESS OF EXTRACTING METALS FROM THEIR ORES. William E. Greenawalt, Denver, Colo. Filed Jan. 16, 1906. Renewed Jan. 29, 1910. A process of extracting copper from its ores consists in dissolving the copper with a suitable solvent; converting the copper in the solution, not already in the form of chlorid, into the chlorid by reacting with the chlorids in the solvents; converting the cupric chlorid into the cuprous chlorid by bringing the solution in contact with sulphur dioxid; maintaining sufficient base metal chlorids in the solution to retain the cuprous chlorid in solution; electrolyzing the solution to precipitate the copper and regenerate acid; and then applying the regenerated acid solution to the ore to extract more copper.

968,677. AUTOMATIC GAS-FEED FOR VACUUM-TUBES. Daniel McFarlan Moore, Newark, N. J., assignor to Moore Electrical Co., New York, N. Y. Filed May 8, 1906. A flexible metal disk is exposed to the gas or vapor in the tube and means responsive to movements of the disk for admitting gas to the tube are also provided.

968,682. ELECTRIC PERCOLATOR. Leon F. Parkhurst and Harry G. Weeks, Binghamton, N. Y., assignors to Diamond Electric Company, Binghamton, N. Y. Filed Sept. 27, 1909. An adjustment between the heater and the base is provided.

968,683. ELECTRIC OVEN. Leon F. Parkhurst and Harry G. Weeks, Binghamton, N. Y., assignors to Diamond Electric Company, Binghamton, N. Y. Filed Sept. 27, 1909. An electric oven has heat-insulating pans arranged adjacent the walls thereof, electric heating units attached to the pans and an electric switch and connections leading from these heating units between the pans and walls to the switch, the latter serving also as a terminal block for the leading-in wires.

968,687. SPARK-PLUG. Herbert F. Provandie, Boston, Mass., assignor of one-half to The Randall-Faichney Company, Boston, Mass. Filed May 18, 1909. An electrode bridge for spark plugs consists of a bar having forked ends formed approximately as semicircles.

968,729. ELECTROMAGNETIC DRILL. Frank E. Baney, Smelser, Wis., assignor of one-half to James E. Kennedy, Platteville, Wis. Filed Apr. 24, 1908. Solenoid coils arranged tandemwise are excited in turn to move the plunger.

968,768. ELECTRIC GRINDING-MACHINE. William A. Ireland, Newburgh, N. Y. Filed Dec. 4, 1909. Includes a traveling carriage, etc.

968,780. MEANS FOR ELECTRICALLY HEATING WATER-COOLED COMBUSTION-ENGINES. Abbot Augustus Low, Horseshoe, and August Wassmann, Astoria, N. Y.; said Wassmann assignor to said Low. Filed March 6, 1907. An annular electrically operated heater is located in the jacket of the cylinder for heating a fluid therein.

968,787. LAMP-FIXTURE. William Sheil Norton, New York, N. Y., assignor of one-half to Lewis Howard Latimer, Flushing, N. Y. Filed Aug. 23, 1909. A fixture for electric lamps has an outer shell provided with a screw-engaging portion for holding the fixture in place, a longitudinally extending member (for supporting the lamp) having an opening extending longitudinally therethrough and provided with a lamp socket, etc.

968,789. MANUFACTURE OF TELEPHONE-TRANSMITTER FACES AND THE LIKE. Valentine Olb, Weehawken, N. J. Filed Oct. 20, 1909. The method of producing a telephone transmitter face or the like, consists in stamping or punching from sheet metal an approximately circular blank, forming the bottom and bending over the edges by successive steps, punching out a central aperture therefrom, and stamping down the edges so as to form an annular recess therein.

968,796. ELECTRIC SAFETY-SWITCH. Clarence D. Platt, Bridgeport, Conn. Filed March 22, 1910. In combination with a casing and cap, each provided with half sockets, is a U-shaped frame removably mounted in the casing, switch mechanism supported by the frame, and an operating shaft journaled in the half sockets.

968,821. SEARCH-LIGHT, PROJECTOR, AND THE LIKE. Hermann Viertel, Charlottenburg, Germany, assignor to Gebruder Siemens & Co., Charlottenburg, near Berlin, Germany. Filed May 25, 1907. An arc lamp comprises a positive electrode, a negative electrode of substantially smaller diameter, an electrically conductive tube surrounding the negative electrode near the arc, and means for rotating the negative electrode within the tube and causing it to project beyond the tube.

968,876. TROLLEY-WHEEL. Patrick F. Morrissy, James Wise, and Walter A. Byrne, Auburn, N. Y., assignors of one-fourth to John X. Coughlin, Auburn, N. Y. Filed Oct. 17, 1908. A trolley wheel comprises sections each having wire-engaging surfaces any two of which are adapted to form a wire-receiving groove when the sections are assembled in wheel-forming position.

968,895. DEVICE FOR STEADYING RECTIFIED CURRENTS. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company, New York, N. Y. Filed Sept. 27, 1905. In a system of electrical distribution, a source of alternating current is connected at its terminals to a vapor converter, and at an intermediate point to the direct current side thereof, a choke coil is in circuit of the rectified current, a resistance in series with the choke coil, and a second choke coil and a translating device in shunt upon the resistance.

968,896. SYSTEM AND METHOD OF ELECTRICAL DISTRIBUTION. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company, New York, N. Y. Filed Dec. 8, 1906. The system includes a circuit and a source of fluctuating electromotive force, a storage device bridged across the circuit and adapted to store electrical energy and to restore the same at a critical electrical pressure, a reactance in the path of current

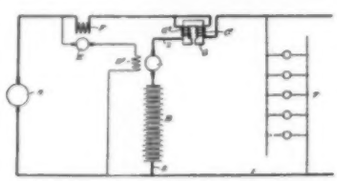
flow of the storage device, and a noninductive shunt containing a source of electromotive force counter to that of the source, bridged across the circuit beyond the inductance.

968,897. SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR-LAMPS. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company. Original application filed May 5, 1906. Divided and this application filed Aug. 20, 1907. There are a number of vapor electric devices, each having a common negative electrode and a plurality of positive electrodes, a temporary metallic circuit through a portion of the device including the negative electrode, a shunt to the metallic circuit, and means for interrupting the metallic circuit inside the device.

968,913. CAR-LIGHTING INSTALLATION. Charles H. Anderson, Seattle, Wash. Filed Apr. 16, 1910. In a railway passenger car are hollow strap-rails secured to the car-body to extend longitudinally therein in elevated position and flanking the longitudinal center thereof, upwardly extending electric lamp sockets secured in the rails, and electric current-conducting wires housed in the rails and connected with the lamp sockets.

968,949. ELECTRODE AND PROCESS FOR MAKING THE SAME. Hendricus Johannes Jacobus Jaburg, Jr., Amsterdam, Netherlands. Filed Aug. 30, 1909. An electrode has a body of hard carbon and a supporting edge made of carbon less dense than the body of the electrode and impregnated with a substance which gives off oxygen when heated.

968,950. TERMINAL CONNECTION. Edwin P. Jahn, Boston, Mass. Filed May 21, 1910. A terminal connection for electric circuits comprises two resilient members shaped to form between them a cylindrical terminal-receiving socket, one of the members projecting beyond the socket and being provided in its projecting portion with an aperture adapted to receive the head of a headed terminal, and a slot leading from the aperture and adapted to receive the neck of the headed terminal, the other resilient



969,007.—ELECTRICAL DISTRIBUTION SYSTEM.

member being provided with a portion which projects beyond the socket and overlies a portion at least of the aperture in the first-named member thereby to constitute a resilient guard finger to prevent the connection from being accidentally disconnected from the headed terminal.

969,004. SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR-LAMPS. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company. Original application filed May 5, 1906. Divided and this application filed Aug. 20, 1907. There are a number of vapor electric devices arranged in series, a source of supply for the lamps, connections from the source to the terminal positive electrodes at each end of the series, and connections through the series from the terminal positive electrodes by way of choke-coils.

969,007. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Storage Battery Company. Filed Feb. 25, 1908. The system includes a main generator, a main distribution circuit connected thereto, a battery and booster in operative relation to the circuit, means for regulating the action of the booster responsive to variations in the electrical condition of the system, and a transformer in series in the main circuit and having its secondary in series with the battery.

969,008. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Storage Battery Company. Filed Feb. 25, 1908. In combination with a main generator are a circuit connected thereto, a storage device and a booster connected to the circuit, and a transformer in the circuit responsive to sudden variations in the electrical condition of the system, the secondary of the transformer being connected to the booster armature for varying the field strength of the booster.

969,055. FOOT-CONTROLLER FOR ELECTRIC MOTORS. John F. Hammond, Prince Bay, N. Y., assignor to The S. S. White Dental Mfg. Co., Philadelphia, Pa. Filed Sept. 23, 1908. A lever and trip device.

969,059. COMBINED GAS AND ELECTRIC-LIGHT FIXTURE. Frank I. Hollingsworth, Denver, Colo. Filed Apr. 23, 1910. A head arranged on the exterior of the lamp socket is provided with a stepped surface, a casing for the conducting wires for the lamp having one end bearing on the stepped surface of the head, and a support passing through the casing and fixedly secured to the head.

969,095. INTERCOMMUNICATING TELEPHONE SYSTEM. Alfred Ekstrom, Stockholm, Sweden. Filed July 15, 1905. The system comprises a plurality of interconnected stations, a telephonic apparatus at each station, including a transmitter and a receiver, a relay which is normally inert and when inert has its actuated contacts included in a local closed circuit with the receiver, and a source of signaling current in circuit with the relay, the source of signaling current when operated being adapted, when connection is made between unengaged stations, to energize the relay at the calling station thereby to break the local circuit and place the telephonic apparatus of the calling station in circuit with the telephonic apparatus of the called station.

969,109. SOLDER FOR INCANDESCENT-LAMP FILAMENTS. Hans Kuzel, Baden, near Vienna, Austria-Hungary, assignor to General Electric Company. Filed Nov. 20, 1906. The solder contains carbid of aluminum and a substance increasing the adhesion of the carbid to metals.

969,133. SAFETY TRANSPORT-CARRIER FOR ELECTRIC INCANDESCENT LAMPS. Mary Isabel Cooper, Hockley, England. Filed June 11, 1909. An incandescent-lamp-bulb carrier comprises a housing having an imperforate bottom, a pair of imperforate side walls and an imperforate hinging top, means for supporting the lamp bulb, and means for sealing the top, the housing being open on at least one side, whereby the whole of the lamp bulb may be examined and electrical connections made to test the lamp before opening the package.

969,147. FOOT-WARMING ATTACHMENT FOR ELECTROTHERMAL GARMENTS. Burton R. Charles, Portland, Oreg. Filed Aug. 7, 1909. In combination with an electrothermal garment provided with wires is a foot piece hinged at or near the bottom of the garment, the wires in the garment extending to and within the foot piece, the latter having uppers at the front end to form pockets for the feet, an element of a fastening device being secured to the foot piece, and a complemental fastening element secured to the garment, the hinge connection between the garment and the foot piece permitting of the latter being folded up and against the former and held by the fastening elements.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired September 5, 1910:

504,336. ELECTRIC BELT. William C. Ekholm, Joliet, Ill.

504,344. THERMAL CUT-OUT. William M. Goodridge, Highland Park, Ill.

504,345. MULTIPLE SWITCHBOARD APPARATUS. William M. Goodridge, Highland Park, Ill.

504,367. CONDENSER TELEGRAPH SYSTEM. Charles H. Rudd, Evanston, Ill.

504,370. SECONDARY BATTERY. William L. Silvey, Lima, Ohio.

504,397 and 504,398. ELECTRIC CONDUCTOR. Joseph W. Marsh, Pittsburg, Pa.

504,401. ARMATURE FOR DYNAMO-ELECTRIC MACHINES. John T. Morrow, Lynn, Mass.

504,454. TELEPHONE TRANSMITTER. Nathaniel Parks, Deansville, N. Y.

504,462. ELECTRIC LOCK. Lemuel B. Tinkham, Quincy, Mass.

504,464. SWITCHBOARD FOR TELEPHONING PURPOSES. Upton H. Balsley, Philadelphia, Pa.

504,475. PENDENT INCANDESCENT ELECTRIC LIGHT. William A. Johnston and John C. Davidson, Prince's Bay, N. Y.

504,484. ELECTRIC LOCOMOTIVE. Augustin I. Ambler, Washington, D. C.

504,492. ELECTRIC AUTOMATIC STEAM GOVERNOR. Edgar A. Edwards, Cincinnati, O.

504,496. ELECTRIC WELDING APPARATUS. Hermann Lemp, Lynn, Mass.

504,497. METHOD OF AND APPARATUS FOR REGULATING ALTERNATING-CURRENT DYNAMOS. Hermann Lemp, Lynn, Mass.

504,528. ELECTRIC SWITCH. Albert B. Herrick, Schenectady, N. Y.

504,542. ELECTRIC RAILWAY SIGNAL. Frank E. Seagrave, Toledo, Ohio.

504,549. CONDUIT ELECTRIC RAILWAY. Benson Bidwell, Philadelphia, Pa.

504,630. METHOD OF OPERATING ELECTRIC MOTORS BY ALTERNATING CURRENT. Alexander Siemens, London, Eng.

504,632. ELECTRIC-ARC-LIGHTING SYSTEM. Thomas Spencer, Philadelphia, Pa.

504,636. TELEPHONE APPARATUS. Alfred Stromberg and Andrew Carlson, Chicago, Ill.

504,676. CONDUIT FOR ELECTRIC RAILWAYS. Samuel H. Flagg, Providence, R. I.

504,681. ELECTRIC CAR-LIGHTING SYSTEM. Isaac N. Lewis, Fort Wadsworth, N. Y.

11,364. ELECTRICALLY-HEATED SOLDERING IRON. George R. Meitzler, Cincinnati, Ohio.